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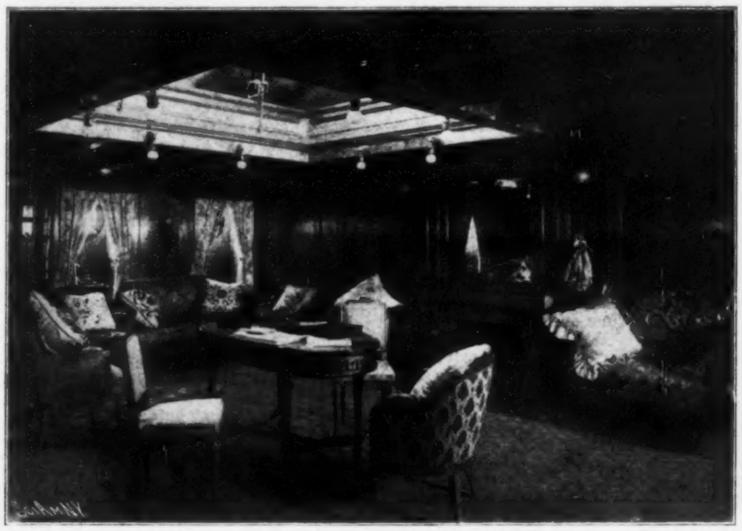
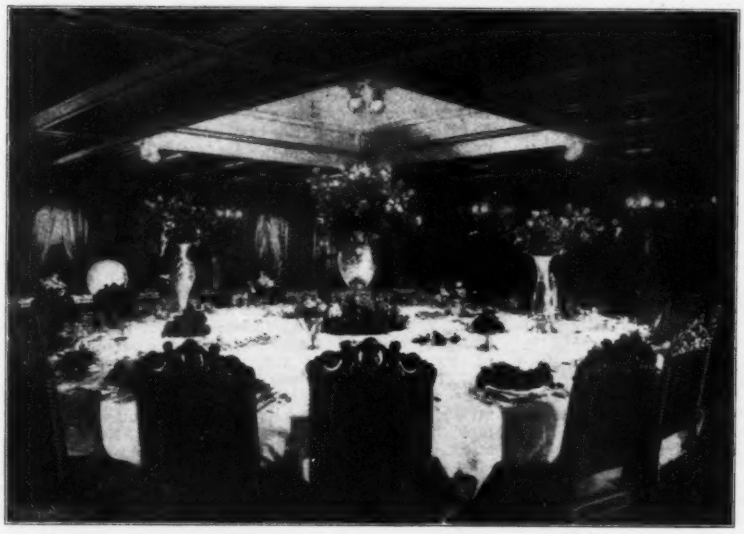
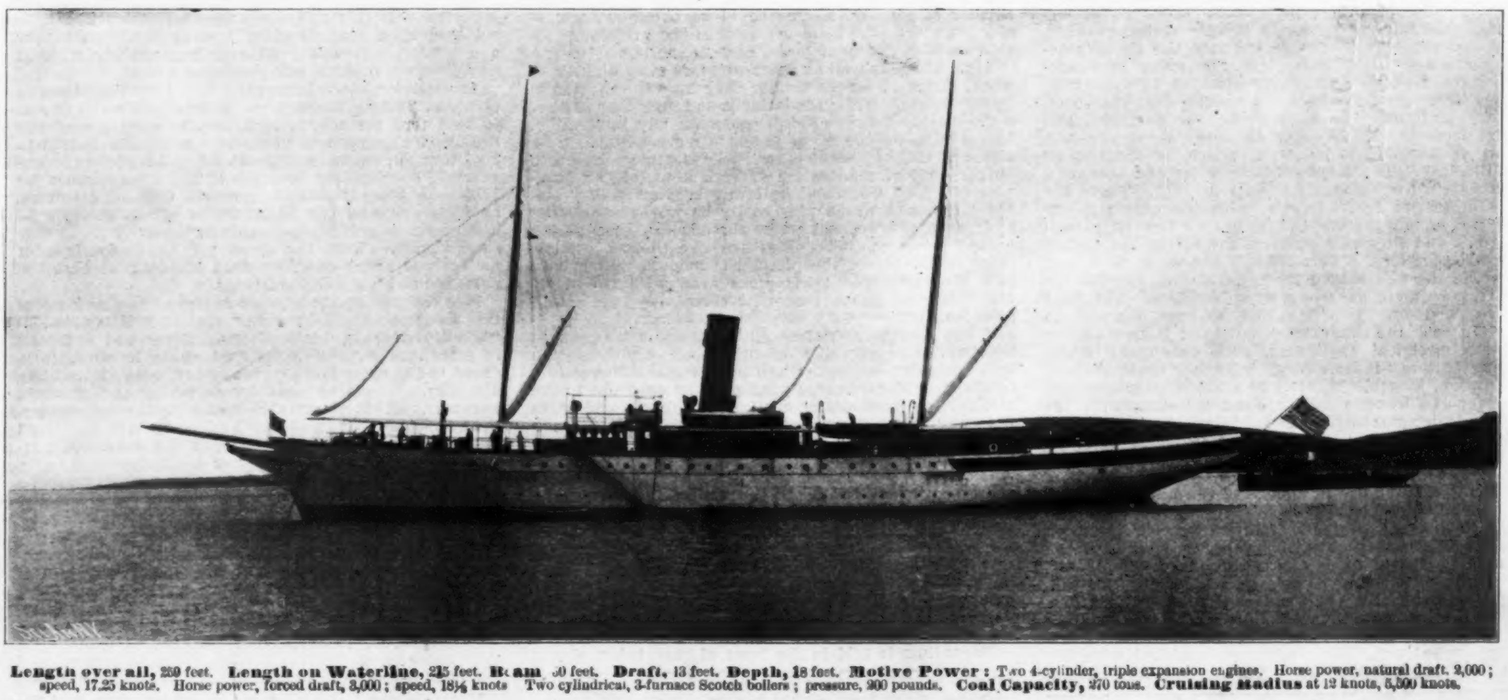


SALOON.



DINING SALOON, WITH ROUND TABLE SEATING EIGHTEEN PEOPLE.

UPPER DECK LOOKING FORWARD.



Length over all, 260 feet. **Length on Waterline,** 215 feet. **Beam** 30 feet. **Draft,** 13 feet. **Depth,** 18 feet. **Motive Power:** Two 4-cylinder, triple expansion engines. Horse power, natural draft, 2,000; speed, 17.25 knots. Horse power, forced draft, 3,000; speed, 18¼ knots Two cylindrical, 3-furnace Scotch boilers; pressure, 200 pounds. **Coal Capacity,** 270 tons. **Cruising Radius** at 12 knots, 5,500 knots.

THE STEAM YACHT "AZTEC."

THE STEAM YACHT "AZTEC."*

THE steam yacht "Aztec," which was designed by Gardner & Cox, of this city, for Mr. Albert C. Burrage, of Boston, is built of steel to the government requirements. Her principal dimensions, etc., are: Length over all, 259 feet; length on water line, 215 feet; beam, 30 feet; draft, 13 feet; depth, 18 feet. She is driven by two four-cylinder, triple-expansion engines of 2,000 indicated horse power under natural, and 3,000 indicated horse power under forced draft, the corresponding speeds being 17.25 and 18.5 knots. The boat is heavily plated and framed, with longitudinal and vertical watertight bulkheads. She has a double bottom, or water bottom, capable of holding over 100 tons of water, extending forward and aft. This water bottom is so subdivided and arranged that fresh water can be carried in it or it can be left empty or salt water used. It is thoroughly cemented inside, and gives an absolute protection to the vessel against grounding on rocks, as it could be torn open on the outer skin for 30 or 40 feet, and yet the vessel remain in a perfectly stable and seaworthy condition.

Accommodations.—One of the greatest advantages of the boat is that the owner's accommodations being forward, he is absolutely private from his guests when he wants to be; while the guests' quarters aft are also subdivided by the lower sitting room or nursery, as it is called, making four staterooms forward of the sitting room and three aft. These seven staterooms, with three bathrooms and the saloon, finished in white mahogany, comprise the guests' accommodations and are reached from the stairway leading down over the after library. Leaving the guests' quarters and going up the stairway to the main deck, you enter the library, finished in Circassian walnut, with bookcases with leaded glass doors. Forward of the library you next pass into the main drawing or reception room on the main deck, which extends the full width of the ship. This is finished in white mahogany and satinwood inlaid. From the reception room, access is had by a well-lighted passageway to the main entrance hall, situated just back of the main dining saloon, from which a stairs goes to the upper deck and also one to the owner's private quarters. This hall has opening into the main gangway, so that guests coming aboard for dinner or any meal will leave their outer wraps, etc., in it and pass either back to the main drawing room, or directly into the dining room. The dining room is finished in waxed, dull-polished teak, inlaid and handsomely carved, with a sideboard and silver closet at its after end in the center, and a fireplace with an elaborate coat-of-arms at the fore end. In each corner of the room are glass cabinets. There are vents for fresh air which carry down to the rooms below. Going back to the lobby and passing down the owner's stairs on the starboard side is a room used by the owner as a private study or office, fitted with a safe under the stairs, typewriter desk, sofa, fireplace and book shelves; opening into which is the owner's bedroom, a large double room with two bureaus, chiffonier and ladies' dressing table. Forward of this again is the owner's private bathroom. Opposite these owner's quarters are three double staterooms for the owner's children, the after one being 15 feet long, fitted so that it can be used as a study as well as sleeping room, with the bathroom opening directly into it, all the finish being in handsome paneled hardwood. Forward of the owner's bathroom, but entirely separate from the owner's accommodations, is the valet's room, having a private stairs, passageway and a private door opening into the owner's accommodations. This comprises the main accommodation of the boat, which consists of twelve staterooms, five bathrooms, a dining room, drawing room, library, and lower aft sitting room or nursery. The stairs from the lobby enter an upper or observation room on the hurricane deck, which is finished in English oak. The accommodations for the steward's and captain's departments are all forward. There are two forecastles for the crew, with the crew's galley entirely separate from the owner's. The engineer's quarters and firemen's quarters are all in the engine compartment on the port side on the main deck, and they are fed and lodged there, thus obviating the necessity for their ever appearing on deck. The boat is equipped with two dynamos, so that one can be used in case the other gives out, and it has all the modern electrical appliances, such as curling irons, cigar lighters, illuminating belts for outside hull decoration, searchlight, etc. She has a telephone system for the owner's use in communicating with the different departments. The "Aztec" has a complement of eight boats, consisting of two launches, two lifeboats, a cutter, a gig and two dinghies. She has double awnings, blue underneath, with a complete outfit of sails for use in steadying the boat as well as to assist in propulsion.

As to the seaworthiness of the vessel, she has been designed with that object specially in view, and she has in addition to her great beam, 30 feet, two deep bilge keels amidships, which decrease the rolling very materially. She possesses an admirable form for a deep-sea cruiser. All the calculations relating to her stability in a seaway and trim have been carefully worked out. The designers furnished with the boat, as with all that they design, what is called a curve of stability, showing the force required to incline her to the different angles in rolling, also the force of the righting lever to bring her back.

Machinery.—The engines, as mentioned above, are of the four-cylinder triple-expansion type. The auxiliary machinery consists of independent air pump, circulating pump, feed pumps, etc., which are all of the best modern make, either Blake or Worthington, and she has in addition an ice plant or ice-making machinery of sufficient capacity to keep the meat room at 28 degrees, and the vegetable room at 46 degrees, and at the same time makes 150 pounds of ice per day. The boilers are of the Scotch return tubular type, with shells of mild steel, over 1¾ inches in thickness, designed to carry 200 pounds extreme pressure, the ordinary working pressure when running at natural draught being about 180 pounds. The boiler room is fitted with blowers and engines, two ash ejectors, and all the modern appliances, and will be very economical of operation. The coal bunkers, which are located longitudinally as well as athwartship, will contain 270 tons of coal, which will take the boat over 5,500 miles without recoaling, at an economical speed at sea.

* Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.

ALUMINIUM ALLOYS.*

By K. PIETRUSKY.

UP to the present time the great hopes which were at first entertained in regard to the use of aluminium, "the metal of the future" as it was called, for industrial and technical purposes, have been fulfilled in a very small degree only. The main reason for this is the fact that this metal, on account of its low degree of solidity, cannot be used for technical purposes without the addition of other substances. As our readers well know, the most important purpose for which aluminium is now employed is as an addition in the manufacture of iron and steel, an art of which our metallurgists only a few years ago hardly ever thought.

However, the characteristic properties of aluminium which gave this metal its great value—i. e., the low specific weight and the silver glossy color—could not fail to lead to many experiments by the addition of other substances, in order to overcome the defect mentioned above. Thus, during the last year a large number of aluminium alloys have been placed on the market, the greater part of which, however, have disappeared again, within a rather short time, as they did not prove to work satisfactorily when given a practical test. The reason for this is said to be found in the fact that, while manufacturing the aluminium alloys, practically only a mechanical mixing takes place between the aluminium and the metal added, always showing, in a more or less marked degree, the defects of such a mechanical mixture. Besides, there is a rather great difference between the melting points of most of the metals employed for such compounds and aluminium. An exception is to be made in regard to the so-called aluminium bronze, but this alloy can hardly be considered an aluminium alloy, as it is practically a copper alloy, judging from the small amount of aluminium it contains—viz., about 10 per cent—and its color and the specific weight.

Among the aluminium alloys recently placed on the market two have especially occupied the attention of metallurgists in a prominent way—namely, "magnalium" and "meteorit"—two German inventions. A report on the properties of these alloys has recently been published by a German contemporary,† from which we take the liberty to quote the following description:

About ten years ago, Dr. Ludwig Mach experimented with alloys for the production of metal mirrors. It was considered indispensable that the composition aimed at should be light, hard, tough and susceptible of polish, and that its gloss should not be easily affected by the air. An equal mixture of magnesium and aluminium proved a very suitable alloy. Following up this discovery Dr. Mach systematically tried all possible proportions of magnesium and aluminium according to their properties and technical adaptability, giving the most approved one the name of magnalium, on the production of which he has obtained patent rights from the Imperial Patent Office at Berlin. Before this various experiments had been made, with a view to the discovery of suitable alloys, but as at that time neither of the two metals could be obtained technically pure, the alloys did not possess the valuable properties which distinguish the new magnalium.

Aluminium, as well as magnesium, is most difficult to work, inasmuch as the former chokes up the file and is liable to break, while the latter is so tough that neither a file nor the turner's chisel can make any impression. Magnalium, on the other hand, is more suitable than either of its component parts. Alloys containing up to 30 per cent of magnesium furnish a metal the hardness of which lies about half way between yellow and red brass, and which may easily be worked with any tool; even the weakest screw threads can be cut with proper keenness. The chips are like those of yellow brass, the faces of the pieces are smooth and bright, and choking never takes place even with the finest files. Magnalium, moreover, is chemically less assailable than either of its components. Aluminium by itself has a very indifferent exterior, while magnesium by itself is greatly affected by the air, and oxidation will gradually extend far into the interior. Magnalium is silvery white, remains unaffected by exposure to the air, nor can ammonia or acetic or sulphuric acid harm it in any way. It surpasses aluminium in gloss, tractability, firmness and lightness.

The combinations of aluminium with copper or with zinc can easily be made, but as these two metals are a great deal heavier than aluminium all the advantages due to the light weight of the latter are lost. While aluminium has a specific weight of 2.7, the alloys referred to range between 3 and 3.5. A notable contrast to this is presented by the specific weight of magnalium, which is less than that of pure aluminium—namely, 2 to 2.5—according to composition. Magnalium produced in Sweden shows a specific gravity of only 2.4 to 2.7.

Magnalium is sold in the form of bars, tubes, sheets and wire. For melting purposes crucibles of graphite or of iron are used, the inside of the latter having been lined with clay and magnesia. Molten magnalium can be poured into the thinnest vessels of a diameter of down to 2 millimeters and of the most intricate forms, and will fill them up thoroughly and faultlessly. It becomes soft at 570 degrees, melts at 600 degrees and becomes fluid at 630 degrees C. On account of its lightness and its silvery white color it is in a high degree suitable for metallic mountings on photographic apparatus, optical instruments and similar articles.

Unfortunately sea water is inimical to magnalium, especially when the latter comes in contact with other metals. This defect renders it, of course, impossible to use the new alloy for ships, as desirable as this might be on account of its lightness and eminent solidity, especially for men-of-war.

In cases in which, for technical purposes, great solidity is of paramount importance, as, for instance, in regard to large castings, an alloy of from 3 to 5 per cent of magnesium is most suitable. An addition of 10 per cent of magnesium would render magnalium brittle, while 30 per cent of magnesium would reduce the solidity of the alloy still more. With only 2.4 per cent of magnesium added, magnalium can be forged at a temperature of 400 degrees C., and will then act in a similar way to copper at red heat. If containing less than 5 per cent of magnesium it may be forged in the cold state, and if perchance the hammering has rendered it too hard it can be made malleable again by heating to a temperature of 500 degrees C. and chilling it thereupon in cold water.

The price of magnalium is about the same as that of copper, and depends mainly upon the price of magnesium. Whereas aluminium may be had (in Germany) for 2 marks (48 cents) a kilogramme, the price of magnesium is kept up steadily at 20 marks a kilogramme. Were it not for the high value of the latter metal the price of magnalium would be considerably lower than that of copper. It is, however, to be expected that the growing demand will lead to an increased production of magnesium, with the result that also this metal will come down much like aluminium, which, as is well known, has experienced an extraordinary reduction within the last few years. The cheapening of magnesium, however, will be the forerunner of more moderate prices for magnalium.

It remains to be seen whether magnalium will fulfill all the promises given above. Our report states in a general way that aluminium-magnesia alloys also show when worked the great defects of mechanical mixture, as hard places frequently occur in the work. If the tool comes in contact with such hard places it frequently breaks, or the material breaks away, whereby the work done may be considered as practically lost.

The Meteorit-Gesellschaft of Berlin claims to have recently succeeded in producing a metal with pure aluminium as the basis which appears to constitute a very noteworthy solution of the problem. This result has been obtained by the company with the metal they produce, and which is now placed on the market under the name meteorit, by the use of elements, especially phosphates, which are chemically combined with aluminium, so that the dissociation which is apt to take place in aluminium alloys on account of the difference in specific weight and melting point is obviated.

The new light metal meteorit may be made in different degrees of hardness, either soft enough for rolling purposes or of a degree of hardness recommending it for delicate mechanical work and for machine construction. A very important feature is that the technological properties of meteorit also meet all requirements of the trade. It may very readily be turned, drilled, cut, etc., without the use of oil or soapy water. If it is ground a splendid polish of silver white color can be attained without difficulty, which is not affected by moisture or any atmospheric influences. Neither is it affected by the organic acids (acetic acid, nitric acid, etc.), nor by the action of neutral salt solutions. Its specific weight is 2.7. It is therefore adapted to replace brass, red brass and many iron parts in vehicles of all kinds. For this reason it is claimed that meteorit is now being used for automobiles to a large extent.

One of the drawbacks to the utility of aluminium has been the defective soldering, whereas meteorit can be soldered by a special solder just as easily as copper and brass. The solder adheres immediately without any previous rubbing being necessary.

As rolling material, meteorit has a tensile strength of about 23 kilogrammes per square millimeter, equal to 14½ tons per square inch, and as casting material nearly 17 kilogrammes per square millimeter, equal to 10½ tons per square inch, with 5.5 to 9.5 per cent elongation. The bending strength is 27.3 kilogrammes, or 17½ tons, the compressive strength 60.3 kilogrammes, or 38½ tons, and the resistance to ordinary strain 35 kilogrammes per square millimeter, or 22 tons per square inch. With the same volume the weight of meteorit is about one-third that of brass, so that the price is not higher than of brass.

It is claimed by the manufacturers of this new metal that as experiments have shown it is well adapted to replace red brass, brass, German silver and argentan in many branches of industry, because it can be produced in the respective degrees of hardness without any difficulty. It can be used for punching and pressing purposes. It is a suitable material for horseshoes. Drawn meteorit tubes, meteorit wire and bars of various shapes have stood their test well for manifold purposes.

In the interest of technical development let us hope that the near future will prove by practical tests the correctness of this statement in all its details.

* Iron Age.

† Deutsche Export-Revue, edited at Stuttgart by the Deutsche Verlags-Anstalt.

Pistachio Extract.—The following formula is published in the Druggists' Circular and Chemical Gazette:

Pistachio nuts	4 ounces.
Cinnamon	1 dram.
Cloves	1 dram.
Lemon peel	¼ ounce.
Diluted alcohol	1 pint.

Macerate for a week, agitating occasionally and filter.

SOME OF THE MORE IMPORTANT SCIENTIFIC PAPERS PRESENTED BEFORE THE WASHINGTON MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.*

By MARCUS BENJAMIN, Ph.D.

ANY attempt to present in a concise way abstracts of the many papers that were presented before the Association at the Washington meeting is obviously impossible, but an idea of the work accomplished during the meeting may be had by the following very brief summary of some of the topics offered before the ten Sections.

The first of the Sections is devoted to Mathematics and Astronomy, and was presided over by Prof. George B. Halsted, who fills the chair of Mathematics in the University of Texas. With this Section the Astronomical and Astrophysical Society of America held joint sessions, the former meeting in the morning, and the latter in the afternoon. Twenty-two papers were presented before the Section, and of these it may be said that O. H. Tittmann, superintendent of the Coast Survey, described some "Deflections of the Vertical in Porto Rico." Secretary Langley, of the Smithsonian Institution, presented "A Device to Prevent the Personal Equation in Transit Observations" and "The Solar Constant and Related Problems;" while Percival Lowell, of the observatory at Flagstaff, read "Spectrographic Proof of the Rotations of the Planets Jupiter, Saturn, and Venus." Retiring President Asaph Hall read a "Note on Secular Perturbations," and the presiding officer, Prof. Halsted, discussed "The Teaching of Geometry" and "The Bolyai Centenary." There were thirty-six papers presented before the Society, and these naturally began with President Newcomb's address on Monday afternoon. The subjects of the papers presented in the afternoon session appear to be more technical than those offered in the morning before the Section. Dr. L. A. Bauer, of the U. S. Coast Survey, gave a "Preliminary Summary of Magnetic Results Obtained During the Recent Eruption in Martinique," and Prof. George C. Comstock, of the University of Wisconsin, presented a "Preliminary Account of an Investigation of the Proper Motions of Faint Stars;" Andrew S. Mitchell, State Chemist of Wisconsin, told of "The New Gases, Neon, Krypton, and Zenon in the Chromosphere," and David P. Todd, of Amherst College, described "A Highly Favorable Type of Instrument for Photographing the Solar Corona;" while Edward E. Barnard, of the Yerkes Observatory, gave the results of his recent work "On the Micrometrical Triangulation of the Stars in the Great Globular Clusters. M. 3, M. 5, M. 13, and M. 92."

Section B is devoted to Physics, and was presided over by Prof. Ernest F. Nichols, of Dartmouth College. There were thirty-one papers read before this section, among which was "The Semidiurnal in the Earth's Atmosphere," by Frank H. Bigelow, of the U. S. Weather Bureau, and "The Construction of a Sensitive Galvanometer," by C. G. Abbott, who has charge of the Astrophysical Observatory of the Smithsonian Institution. Past President Edward W. Morley, of the Western Reserve University, and so well known for his work on Atomic Weight of Oxygen, presented in association with Dayton C. Miller, papers "On the Velocity of Light as Affected by Motion Through the Ether" and "Some Measures of the Speed of Photographic Shutters." Henry S. Carhart, of the University of Michigan, discussed "Why the E. M. F. of the Daniell Cell Changes When the Densities of the Solutions Change," and Charles K. Weed, of the Patent Office, described "Some Relations Between Science and the Patent System;" while A. Lawrence Rotch, of the Blue Hill Observatory, spoke on the "Atmospheric Circulation Near the Equator." On the conclusion of the reading of these papers, the American Physical Society, of which Albert A. Michelson is president, convened, and twenty-four papers were then presented before that organization. Among these, perhaps the most original was on "The Magnetic and Electric Deviation of the Easily Absorbed Rays from Radium," by E. Rutherford, of McGill University, Montreal, Canada, in which he gave the results of his late researches on radio-activity. Similar papers showing that our American physicists are actively pursuing this new branch of science was apparent by the three following papers: "Induced Radioactivity Excited at the Foot of Water Falls," by J. C. McLennan, of Toronto University; "Radioactivity of Freshly Fallen Snow," by S. J. Allen, of McGill University, Montreal, Canada; and "Note on the Possible Cause of Radioactivity," by Carl Barus, of Brown University. Prof. W. J. Humphreys, of the University of Virginia, described "A Comprehensive Boyle's Law Apparatus" and "A Lecture Room Method of Analyzing Irregular Electric Currents," and Prof. Edwin H. Hall, of Harvard University, discussed the question, "Is there a Southerly Deviation of Falling Bodies?"

The Section on Chemistry met continuously with the American Chemical Society, and in all thirty-eight papers were read before the joint meetings. The Section was presided over by Dr. Charles Baskerville, who fills the chair of chemistry in North Carolina. Dr. Ira Remsen, the retiring President of the American Chemical Society, took as the subject of his annual address, "The Life History of a Doctrine," in the course of which he said: "The doctrine of atoms is still alive, though it came into being about a hundred years ago. It has been proved to be illogical, as the ether that fills all space has been shown to be incapable of existence. Properties must be ascribed to the atom that it cannot possess, and the same is true of the ether. What are we to do? Throw over the atom and the ether? Although both have been convicted of being illogical, I do not think it would be logical to give them up, for they are helpful in spite of their shortcomings. While the atomic theory can be used without using atoms, this must involve a great effort for the average mind. Why should we make the effort? If we can get a broader and deeper and clearer view of chemical phenomena by making the effort, by all means let us make it. Can we? That is the whole question. Apparently, not enough chemists have made the effort to furnish us with the necessary data upon which to base a conclusion. The atom has thus been followed in its career down to to-day. The changes in our conceptions have been traced sufficiently for our purpose. It is at present a bundle of attributes, and with these attributes it is a convenient nucleus for thought. Nothing has been said of the dynamics of the atom, by which I do not, of course, mean chemical dynamics in general. So far as the atom is concerned, our knowledge of its motions may perhaps fairly be summed up by saying that it seems probable that it moves in some mysterious way, and perhaps the phenomena of chemistry are all due to this motion, but that is speculation pure and simple, and has no right to further consideration." Before this Section Dr. F. W. Clarke presented his reports "Of the Committee on Atomic Weights" and "Of the International Committee on Atomic Weights," as well as described at some length "The Chemical Work of the U. S. Geological Survey." Of similar nature were descriptions of "The Chemical Work of the Bureau of Soils, Department of Agriculture," by Frank K. Cameron of that Bureau, and "Nature of the Work of the Bureau of Chemistry, Department of Agriculture," by H. W. Wiley of the same department. An exceedingly important paper was one on "Tuberculosis from Milk," by Dr. E. A. de Schweinitz, Chief of the Biochemical Division of the Department of Agriculture. The experiments described by him showed beyond dispute that virulent tuberculosis germs obtained from a human being would cause the disease in cattle. Milk he showed to be a source of danger. In closing he said: "As the result of this work we have carried on a number of experiments on the production of a curative substance for tuberculosis, and, while the end has not by any means been reached, results have been obtained which help us to a still clearer understanding of this scourge." Among the more practical papers were "The Composition of Fresh and Canned Pineapples," "Chemical Composition of Some Tropical Fruits and Fruit Products," and "The Composition of Spirits Produced from Grain, and the Changes Undergone by the Same when Stored in Wooden Packages," which likewise gave the result of investigations conducted in the chemical divisions of the Department of Agriculture.

Section D, which is devoted to Mechanical Science and Engineering, was presided over by Prof. Clarence A. Waldo, of Purdue University. Twenty-four papers were presented before this Section, among which were such popular subjects as "Cementation of Road Material and Elasticity of Clays," by Alerton Cushman; "Agricultural Engineering," by Elwood Mead, and "The Drainage Problems of Irrigation," by C. G. Elliott; while a description of the "Topographic Work U. S. Geological Survey," by H. M. Wilson, and "Hydrographic Work of the U. S. Geological Survey," by H. H. Presley, were read. One of the most interesting papers, which was essentially an illustrated lecture, was by Bernard R. Green, on "Construction of Washington Monument and Library of Congress."

Topics on Geology and Geography were all read before the Geological Society of America, and papers belonging properly to Section E were presented through members of that Society. The presiding officer of the Section was Prof. William M. Davis, of Harvard University, and forty-six titles were offered. The more popular of these papers were those on the West Indies, and these began with an illustrated lecture on "Martinique and St. Vincent," by Israel C. Russell, University of Michigan, complimentary to the citizens of Washington, and also the following papers: "The Geological Age of the West Indian Volcanic Foundation," by J. W. Spencer; "Mont Pelé, the Eruption of August 30, 1902," by Angelo Heilprin; "The Principal Causes of Death During the Eruptions of Mont Pelé and La Soufrière," by Israel C. Russell; "Secondary Volcanic Phenomena of the West Indian Eruptions of 1902," by G. C. Curtis; "History of the Caribbean Islands from a Petrographic Point of View," by Persifor Frazer; "Some Erosion Phenomena on Mont Pelé and La Soufrière" and "The Inner Cone of the Mont Pelé Crater and its Relation to the Destruction of Morne Rouge," by E. O. Hovey, of the American Museum of Natural History; and "The Geological and Physiographic History of the Lesser Antilles," by R. T. Hill, of the U. S. Geological Survey. Other papers presented before this Section will be described more fully elsewhere in this journal (by Dr. E. O. Hovey).

Section F, on Zoology, was presided over by Prof. H. Argitt, who fills the chair of Zoology in Syracuse University, and forty papers in all were presented before the Section, and affiliated societies, of which the two more important were the American Society of Naturalists, with J. McKeen Cattell as president, and the American Morphological Society, with H. C. Bumpus as president. Among the more important papers were "Tadpoles of the Green Tree Toad," by Simon H. Gage, of Cornell University, and "The Eyes of a Specimen of the Cuban Blind Fish, Lucifuga, and Those of Her Young," by Carl H. Eigenmann, of Indiana University; while G. H. Parker, of Harvard, described the "Sense of Hearing in Fishes." An exceedingly interesting description was "An Exhibit of Lantern Slides Illustrating the U. S. S. 'Albatross' and Her Work," by Charles C. Nutting, of the University of Iowa, who accompanied the expedition as naturalist. F. L. Washburn, of Minneapolis, presented the reviews of "Certain Attempts to Introduce the Eastern Oyster into the Bays of the Oregon Coast" and "Of Certain Efforts to Acclimatize the Eastern Oyster in the Bays of Oregon, Enumerating the Natural Difficulties Encountered." Theodore Gill, of the U. S. National Museum, presented papers on "The Bones of the Shoulder Girdle of Fishes," of which subjects he is recognized as first authority; and Oliver P. Hay, of the American Museum of Natural History, described "Some Remarkable Fossil Fishes from Mt. Lebanon, Syria." The Entomological Club of the Association, which has been dormant for some years, resumed its meetings in connection with this Section, and steps were taken toward organizing it into a permanent society.

The papers on Botany were presented before Section G, of which Frederick V. Coville, Chief of the Division of Botany in the Department of Agriculture, was the presiding officer, and the titles of twenty-nine papers were presented. With this Section also met the Botanical Society of America, of which B. F. Galloway was president, and before which forty-one papers were read, and also the Botanical Club of the Association, before which four titles were read. Douglas H. Campbell, of the Leland Stanford Junior University, presented papers on "Antithetic U.S. Homologous Alternation" and "Studies in Araceæ;" and W. W. Rowlee, of Cornell, spoke on "The Pines of the Isle of Pines." Among the more popular papers may be mentioned "The Desert Botanical Laboratory of the Carnegie Institution," by Daniel P. MacDougal, of the New York Botanical Garden; and Nathaniel L. Britton from the same Institution described his "Recent Botanical Explorations in Bolivia." Among the practical studies were papers such as "A Fungus Disease of the Mulberry Fruit," by W. A. Orton, and "The Production of New Varieties of Oranges," by H. J. Webber and W. T. Swingle, all of whom are from the Department of Agriculture. Fossil botany was represented by Arthur Hollick, who described "A Fossil Petal of Magnolia from the Dakota Group of Kansas," and applied botany was considered in the two papers, "Alkaverdin, a Hitherto Unknown Pigment, Found in Leaves of Sarracenia Purpurea" and "The Digestive Action Ensuing in the Pitchers of Sarracenia Purpurea," by W. J. Gies, of the Medical Department of Columbia University of New York city.

Section H, on Anthropology, was presided over by George A. Dorsey, of the Field Columbian Museum, and the Section held joint sessions with the American Anthropological Association, of which Dr. W. J. McGee was president, and the American Folk-lore Society, of which Mr. Dorsey was also president. The titles of forty-seven papers were presented before the joint meetings of the three organizations. Miss Alice C. Fletcher, of the Peabody Museum of Cambridge, described "Pawnee Star Lore," and Stewart Culin, of the University of Pennsylvania, whose specialty is games, described "The Tube-Guessing Game of the American Indians." William H. Holmes, Director of the Bureau of Ethnology, presented interesting papers on "Fossil Human Remains Found near Lansing, Kan.," and "Incrusted Crania from Caves in Calaveras County, Cal." "The International Archæological and Ethnological Commission" was reported on by W. J. McGee, who had just returned from the meeting in the city of Mexico; and E. W. Scripture, of Yale, discussed his experiences with "The Gramophone Method in Collecting Dialects." Robert Bell, of the Geological Survey of Canada, related legends of the "Hurons," "Wabiniki," and "Montagnais," and George G. McCurdy described "Progress in Anthropology at the Peabody Museum, Yale University." "The Mythology of the Yurok," by A. L. Kroeber, of the University of California; "Haida Mythology," by J. R. Swanton; and "System and Sequence in Maidu Mythology," by Roland B. Dixon, of the Peabody Museum, Cambridge, were studies, the presentation of which attracted considerable attention.

An exceedingly interesting programme of papers on topics connected with Social and Economic Science was presented before Section I, over which Harry T. Newcomb, editor of the Railway World, Philadelphia, presided. "The Necessity of Organization Among Employers" was presented by David M. Parry, president of the National Association of Manufacturers, while Walter S. Logan, of New York, discussed "The Right of the Laborer to His Job." Judge Martin A. Knapp, chairman of the Interstate Commerce Commission, interested the Section with some "Remarks on Capitalization and Publicity;" and Roland P. Falkner, Chief of the Division of Documents, Library of Congress, presented "Recent Aspects of the Immigration Problem." The mornings of two days were devoted to the consideration of a series of papers which were remarkable as showing the development of certain phases of government work. The series showing the relations of the United States to our foreign dependencies was most satisfactorily developed in the following papers: "The Pan-American Union and the Bureau of American Republics," by Hon. W. W. Rockhill, Director of the Bureau of American Republics; "Work of the Bureau of Insular Affairs," by Col. Clarence R. Edwards, Chief of the Bureau of Insular Affairs, War Department; "The Consular Service and Foreign Trade," by Hon. Frederic Emory, Chief of the Bureau of Foreign Commerce, Department of State; "The Relation Between Imports and Exports," by Hon. T. E. Burton, U. S. House of Representatives; and "Tropical Development a Necessity of World Progress," by Hon. O. P. Austin, Chief of the Bureau of Statistics, Treasury Department. Similarly, "The Economic Work of the Department of Agriculture" was set forth in ten-minute talks by the following Chiefs: Willis L. Moore, of the Weather Bureau; D. E. Salmon, of the Bureau of Animal Industry; B. T. Galloway, of the Bureau of Plant Industry; H. W. Wiley, of the Bureau of Chemistry; Milton Whitney, of the Bureau of Soils; A. C. True, of the Office of Experiment Stations; L. O. Howard, of the Division of Entomology; and C. Hart Merriam, of the Division of Biological Survey.

From the foregoing list of papers presented before the sections, sufficient evidence is offered to warrant the statement that has been made, that the Washington meeting was the most successful meeting ever held by the American Association for the Advancement of Science.

* Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.

PRESERVES IN BRICKS.

THE Kansas City Packer relates that the newest form of preserved fruit is bricks, which are either rectangular or disk-shaped and done up in oiled tissue paper. They are of about the consistency of a soft gumdrop, and, being composed largely of sugar, they hold the flavor of the strawberries, peaches, pears, plums, or what not, admirably. These bricks will soon be on the market in large quantities from California, experiments in their manufacture having attained final success. They are made by boiling down the fruit pulp to a sugar until the desired consistency is reached, when the mixture is poured into pans and permitted

to dry slowly for ten hours, being eventually cut into suitable pieces and wrapped in the manner described. They will keep in perfectly good condition for years. Old-time housewives used to make plum or cherry "cheeses," as they called them, which were so stiff that fanciful forms could be stamped out of them with a pastry cutter. This delectable quality of stiffness, as well as the absence of stickiness, was attributable to the boiling, which was brought to exactly a certain point (after putting the fruit through fine sieves), in order to turn the sugar to candy. It is the same principle that is used in the manufacture of the fruit bricks, which, when they are to be used, are soaked preliminarily in warm water for an hour. They are said to be almost like the fresh fruit, being readily utilized for pastry and other desserts, and their cost is moderate. Before long, doubtless, they will be for sale in all the grocery shops. The production of fruit pulps in other shapes has already become enormous in this country, most of them being put up in cans for the flavoring of ices and soda-water. One can buy in this form apricot pulp, peach pulp, apple pulp, pineapple pulp, quince pulp, and various others. Strawberry pulp we are exporting in large quantities to Europe.

WATER TUBE BOILERS.—V.

By the English Correspondent of the Scientific American.

THE NICLAUSSE WATER TUBE BOILER.

In the French navy, as well as in connection with steam generating for stationary purposes, conspicuous success has been attained by the Niclausse boiler. In fact, it is now regarded by the French Naval Department as the standard boiler, all the latest vessels of the navy being equipped with this steam generator, while it has also proved satisfactory in six American battleships.

From a brief glance at a longitudinal section diagram the Niclausse boiler may be said to resemble in outline the Babcock and Wilcox water tube boiler, but the similarity is a very slight one. Instead of having two headers, as is the case with the latter type, the Niclausse has only one header, which is divided so as to allow for both the upward and downward flows. The large water and steam drum is at the top, and the tubes are inclined at a slight angle above the furnace. It will be noticed by reference to Fig. 2 that the rear ends of the tubes are sealed, and are not even

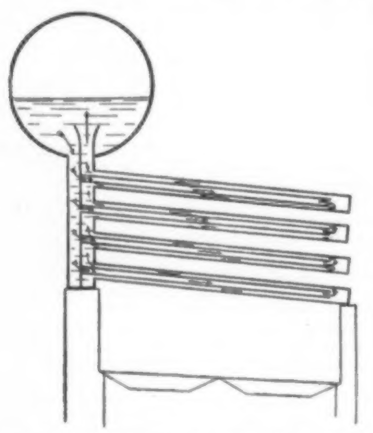


Fig. 1.—THE NICLAUSSE BOILER, SHOWING INNER TUBES AND PRINCIPLE OF CIRCULATION.

fixed to stays of any kind. The water flows from the water drum down the one side of the division plate of the header, and is conveyed to the rear end of each steam-generating tube by an inner circulating tube. In other words, there is a tube within a tube, the internal tube being open at its rear end so that the water can flow into the space between the inner and outer tubes, and when converted into steam travels toward the header, rising up the division in the header to the water drum above, the steam being delivered into the latter below the water line. This peculiar arrangement of the tubes constitutes one of the main features of the Niclausse boiler. The great advantage of this system is that as the tubes are only fixed at one end, there is no interference with any contraction or expansion that may be set up, by fluctuating temperatures, and thus no fixed parts are subjected to racking strains, nor is the attachment of any other adjoining tube compromised in any way. As the tubes are also in parallel, the water is only in the presence of the heated gases from the furnace for a short time in making each complete circuit. The water delivers the steam at frequent intervals to the drum, and before it has formed in sufficient quantity in the tube to allow any danger of the latter overheating. There is also the additional important fact to observe, that as all the tubes of an element or series discharge the steam into the upcast portion of the header or upcomer, although the latter may contain a preponderating quantity of steam, no fear need be apprehended as to the safety of the header since it is not exposed to sufficiently hot gases to cause any injury. The arrangement is very simple, and there is an entire absence of joints in the proximity of the furnace so that all possibilities of leakage are obviated.

The tubes, as will be seen by referring to the longitudinal section diagram, pass completely through the headers, from back to front, which arrangement results in the headers being relieved from pressure upon their front and rear surfaces. As a matter of fact, the pressures are self-contained so far as the area of the tube is concerned.

The fitting of the tubes into the header in the Niclausse boiler is peculiar when compared with the general system adopted for fixing the tubes into position. Instead of expanding the end of the tubes into place, they are adjusted by means of cones, and are simply pushed (very slight pressure being necessary for the operation) into coned holes, the front cone being a little larger than the rear one, so that the latter may pass through the hole which receives the front one. At first sight, the utilization of these double cones may appear to constitute an element of weakness, especially in relation to perfect and permanent tightness, but the opposite is the case. The cones are turned to a special shape, so as to obtain a certain amount of elasticity, and this arrangement is responsible for both the cones remaining perfectly tight simultaneously

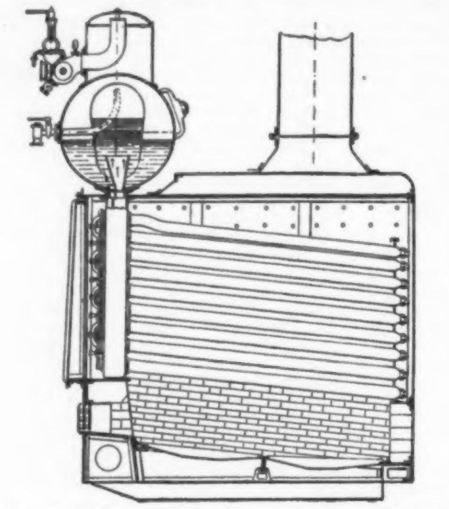


Fig. 2.—VERTICAL SECTION OF BOILER, SHOWING ARRANGEMENT OF TUBES AND HEADER AND CIRCULATION TO STEAM AND WATER DRUM.

under all degrees of temperature. A similar system is adopted in connecting the header with the horizontal steam and water drum. By this process a defective tube can be removed and replaced with facility and expedition.

Our third diagram comprehensively illustrates the attachment of a tube to the header by these double cones. *A* is the outer cap closing the front end of the tube screwed to receive an inner plug, *B*, carrying the inner tube, *C*, through which the water enters after passing down the downcast of the header. *D E* are the cones which fit the outer tube into the front and back of the header, passing through the plate which divides the downcomer from the upcomer, by an "easy fit." *F G* is a similar diaphragm division. The rear end is closed by a cap, *H*, which is sufficiently small to pass through the orifice in the header when it is desired to withdraw and insert a new tube, this operation being carried out from the front. To inspect the inside of the tubes it is only necessary to unscrew the plug, *B*, and withdraw the inner tube, *C*. The latter is made of light sheet metal since it has to resist no pressure. To withdraw the outer tube itself is an easy and quick matter, and much more advisable, since, as it carries the inner tube, when withdrawn the latter can easily be inspected at the same time.

By passing the tube right through the header a great increase in the strength of the boiler is obtained. If the tube were simply expanded into the rear face of the header, all the pressure exerted against the rear end of the tube would be forced upon the rear face of the header; and as the strength of the latter is already appreciably decreased by the holes cut into it for the admission of the tubes, such a fitting by expansion would result in a decided weakening of the structure.

As all the tubes and attendant fittings are made to standard size, when a tube is withdrawn another can be substituted immediately, thus allowing the removed tube to be cleaned at leisure. As a matter of fact, this arrangement constitutes one of the greatest features of the Niclausse boiler, and the removal and inspection of a tube, when opportunity offers, is the method generally adopted whenever the Niclausse boiler is used.

The steamboats on the Seine, at Paris, are in thirty-five cases fitted with this type of water tube boiler, and there is one reserve set of tubes divided among the fleet, and these tubes are used when those in service are removed for cleaning, the withdrawn tubes being used as spares in turn. The tubes are extremely durable, not one among this fleet of thirty-five river boats having been condemned since they were installed, in 1893. As already pointed out, the withdrawal and insertion of a new tube can be carried out very quickly. On one of the French cruisers the exchange was carried out in two minutes. Even when the boiler is in use, the exchange is achieved very expeditiously, as the British Admiralty proved by a practical test on the gunboat "Seagull" under service conditions. The fires of one boiler were drawn, a tube changed, the boiler refitted and steam raised again in 35 minutes.

For cleaning purposes this boiler also possesses several noteworthy and recommendatory features, owing to the inclination of the tubes; and the rear ends of the tubes being closed by a cap, the tubes can not be merely emptied by blowing off in the usual way. Even when the drum and header are emptied, the tubes still contain their full quota of water. This is a distinct advantage, for it is a well-known fact that impurities in the water when deposited in a muddy form may be easily withdrawn when in that condition; but if the boiler is completely emptied, the deposits will form a hard scale on the surfaces of the tubes. If, however, it is desired to empty the tubes of the Niclausse boiler, this can easily be accomplished by withdrawing the inner tube, and inserting a specially designed nozzle of a small pump into the outer tube, and thus removing the water.

In the early marine types of the Niclausse boiler, tubes of 3¼ inches were used; and although this larger diameter is still employed for large war vessels, experiments and investigations have resulted in a modification of the diameter of the tubes for boilers supplied to the smaller naval vessels. For the latter, tubes of about 1 9-16 inch diameter are employed; and from long use it has been proved that the small tubes are in every way as efficient, both in horse power and fuel consumption, as the boilers fitted with the larger size tubes. The employment of the small tube type of boiler for the largest vessels would be a great advantage, since thereby a great economy would be effected in the weight per horse power, while the parts owing to their decreased size would be much more convenient for handling.

The tubes are of great strength, and do not bend even under the most excessive temperatures, and the boiler withstands forcing extremely well. The remarkable durability of the tubes was established by the French Naval Department, which ordered the warship "Friant," the first naval vessel equipped with Niclausse boilers, after three years' active service to undertake suddenly, and without any preparations whatsoever, 144 hours' continuous run at 16 knots, to be followed immediately by a 15 hours' run at 17 knots. Had the boilers possessed any inherent defects, the first test alone would have developed them, but the vessel covered the run at the authorized speed without any mishap whatever. The second test at the maximum speed, which meant extreme forcing of the boilers, was still more exacting, but this, too, was accomplished successfully. At the conclusion of the 15 hours' run the vessel was ordered to port, and a rigid examination made of the boilers. The tubes were tested to ascertain if the strain had caused them to bend, but they were as true and as straight as when first inserted, while they were also free from any other deterioration. The French Naval Department were eminently satisfied with the result of the trials, and the boiler was forthwith installed upon other vessels. To-day it is the standard boiler of the French navy.

In order to obtain conclusive data regarding the evaporative capacity of the tubes according to their proximity to furnace gases, the inventors carried out a series of experiments with a specially built boiler. It contained twenty-four tubes arranged in pairs in twelve rows. Each row or stage had an independent feed and water supply, the latter being predetermined. The test comprised evaporative capacity at varying rates of combustion ranging from 10 pounds to 61 pounds of fuel per square foot of grate. The result was somewhat remarkable, since the evaporative capacity was found in each stage to be precisely similar at all rates of combustion. The first or lowest row being the nearest to the furnace gases, naturally showed the highest evaporative efficiency—nearly one-quarter; the first three stages, nearly one-half; and the first six rows, approximately two-thirds of the whole. The highest stages—the farthest removed from the radiant heat—showed an evaporation of 3¾ per cent. From the result of this test it will not only be observed that the boiler has a high evaporative efficiency, but is also most regular in its working. This latter requirement is further insured by making the grate wide and shallow and by the provision of large combustion space, so as to obtain regular heating of the tubes throughout the entire length.

Owing to the peculiar construction of the header, and its use for both descending and ascending currents, which, however, are completely separated by means of the diaphragm, combined with the independent discharge of the steam from each tube into the collector with a short passage to the steam drum, which insures a larger disengagement surface and slow velocity in formation, the steam has a high degree of dryness. With very rapid steaming the measure does not exceed one per cent, which is a very low percentage.

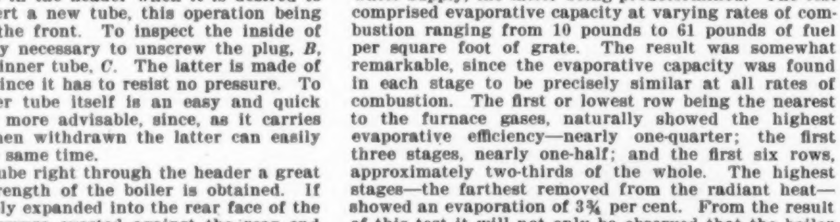


Fig. 3.—SECTION OF HEADER, SHOWING CONE FITTINGS AND ATTACHMENT OF A TUBE TO THE HEADER.

. . . .

In the foregoing articles an attempt has been made to explain in a lucid and comprehensive manner the most salient characteristics, construction, and methods of circulation, of the best-known types of water tube boilers—that is, those which have proved their efficiency and capacity in actual practice. Each of the boilers described possesses a distinct individuality and a distinct process of circulation. But it must by no means be thought that the list of water tube boilers is exhausted. Far from it. Now that this process of steam generation is rapidly forging to the front, and is supplanting the cylindrical boiler, both in the merchant and naval services, new types of water tube

boilers are springing into existence every day with almost mushroom growth.

The Committee on Naval Boilers organized by the British Admiralty to investigate the various types of water tube boilers, examined the principles and tested as far as possible no less than thirty-six different types of water tube boilers. This will supply a very fair estimate of the importance of the water tube boiler question to marine engineers.

Several of these designs, however, are based more or less upon an existing type. For instance, the Dürr boiler is closely similar in construction, and working, to the Niclausse boiler. Indeed, the description we publish of the latter may also pass for the Dürr boiler. The Blechynden possesses features in common with the well-known Yarrow boiler, the main difference being that the tubes are not straight, but are all slightly curved, and the outer rows shield the casing in much the same manner as the Thornycroft boiler.

The British Naval Boiler Committee carefully considered the claims of all the types submitted to them; but although it was suggested that many might prove satisfactory for small vessels, they did not appear suitable for ships larger than third-class cruisers. The four types specially suggested as being suitable for large vessels were the Yarrow, Babcock and Wilcox, Niclausse, and Dürr boilers.

No description of water tube boilers would be complete without a brief reference to the report of the Boiler Committee of the British Admiralty, since the value of the result of these investigations cannot be overestimated, owing to the extreme care, time, and expense incurred by the British Naval Department to solve the problem as to which is the best type of water tube boiler.

It is the thesis of the manufacturers and engineers interested in this system of steam generation that the water tube is more economical than the cylindrical boiler. But the Boiler Committee maintain a diametrically opposite opinion. They say that "no type of water tube boiler at present in use is, on general service, as economical as the cylindrical boiler; also, that a large percentage of the coal used is expended for auxiliary purposes in harbor. Until a thoroughly satisfactory type of water tube boiler is obtained, the Committee therefore recommend that in large cruisers and battleships cylindrical boilers of sufficient power to work the auxiliary machinery and to drive the ship at her ordinary cruising speed should be fitted; the steam pressure should be the same for the water tube and cylindrical boilers, and may conveniently be 210 pounds per square inch, so as to give 200 pounds at the engines. By this means considerable saving in coal will be effected, with a corresponding increase in the radius of action and general usefulness of the vessel. The water tube boilers could be kept clean and perfectly efficient, as they need only be used for driving the ship at high speeds, when economy of coal relatively is not so important. The cylindrical boilers should be fitted with retarders in the tubes and with special means for circulating the water while raising steam."

This principle of combined water tube and cylindrical boilers is already being adopted upon vessels now being built. It is already in vogue in connection with the large battleships of the German navy, and has been attended with marked success. The boiler has now developed into an acute problem both for naval and ordinary commercial purposes; and in view of the decided stimulus that has been imparted to this system of steam generators, engineers interested in the question are redoubling their efforts to design water tube boilers which, while possessing the present characteristics of the conventional cylindrical boiler, will also contain in a developed form the very features which have brought the water tube boiler into such prominence.

A NEW PORTABLE STONE CRUSHER.

WE illustrate herewith a portable stone crusher devised and manufactured by the American Road Machine Company, and called the "Champion Crusher."

The crusher is generally mounted upon wheels, in order that it may be readily moved to the place where it is to be used. It is provided with a suitable pulley and a belt for transmitting the power from the motor that actuates it. This motor may be a steam one for important installations in which, for example, the crushing of stones for a number of roads is centralized at a single point, or a gasoline one for a movable installation.

The action of the crusher will be at once understood when we have said that the large stones to be crushed are thrown into the apparatus at *P*, and in descending are rapidly crushed between cast steel plates, *N* and *O*, owing to the reciprocating motion of the former, which is stationary, and of the latter, which is secured to a movable jaw, *B*. The motion of the belt is transmitted to the movable jaw in the first place through the intermedium of the pulley shaft, which is provided in the center with a double cam. Therefore, every time that the pulley makes a half-revolution, the cam acts upon the counterfriction roller, *E*, and upon a tumbler, *D*, capable of oscillating around the shaft, *S*, as a center. Every motion of the tumbler, *D*, thrusts the piece, *G*, which has a tempered surface and may receive a greater or less inclination according to the amplitude of the motion that it is desired to give the movable jaw. It is this piece, in fact, that gives a quick thrust to the latter by abruptly entering the recess prepared for it. Moreover, every apparatus is provided with a set of these pieces, *G*, of various sizes, in order to permit of breaking stones into pieces of varying coarseness. Finally, the rod, *J*, and

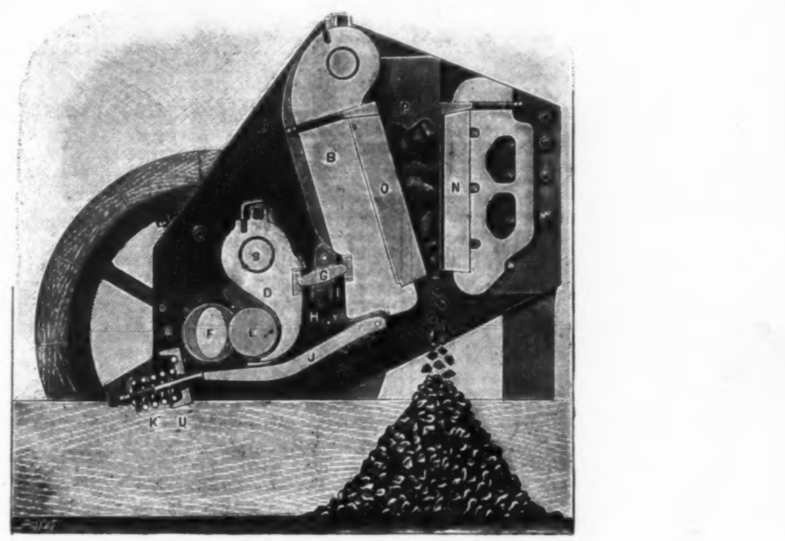


FIG. 2.—DETAILS OF THE CRUSHER.

the opposing springs, *K U*, have always a tendency to pull the movable jaw backward. This latter has a continuous vibratory motion which causes it to strike the stones descending by gravity between the plates, *P*, of the receiving chamber. The stones, after being crushed, by the jaws, fall into the buckets of an endless belt, which raises them to a screen that automatically separates the dust and the small stones, and discharges those of proper size into dump carts.—Translated for the SCIENTIFIC AMERICAN SUPPLEMENT from La Nature.

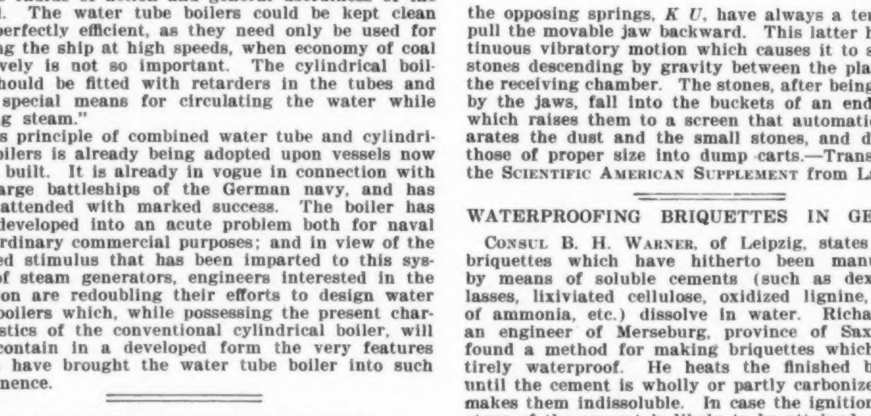


FIG. 1.—AN AMERICAN STONE CRUSHER.

WATERPROOFING BRIQUETTES IN GERMANY.

CONSUL B. H. WARNER, of Leipzig, states that all briquettes which have hitherto been manufactured by means of soluble cements (such as dextrin molasses, lixiviated cellulose, oxidized lignine, resinate of ammonia, etc.) dissolve in water. Richard Bock, an engineer of Merseburg, province of Saxony, has found a method for making briquettes which are entirely waterproof. He heats the finished briquettes until the cement is wholly or partly carbonized, which makes them indissoluble. In case the ignition temperature of the cement is likely to be attained, the heating must take place in an air-tight case or by means of hot gases.

PROCESS OF BRAZING CAST IRON.

AT a meeting of foundrymen in Philadelphia, a few evenings ago, Mr. H. Armor Ward explained the newly discovered process of brazing cast iron. In the course of his remarks Mr. Ward said:

The discovery of this process has changed the methods in European foundries with reference to complicated castings, especially in the case of large castings where a flaw or imperfection of any kind involved the relegation of the piece to the scrap pile. The patterns were now cut into two or more parts, so that each was a simple piece to mould, and the several parts that went to make up the whole were brazed together, so that in effect when the brazing operation was complete, the several pieces that went to make up the whole casting were as one entire casting, and the cost of production had been reduced, in that the cost of brazing was very much less than the cost of molding one large casting. Mr. Ward explained that flaws in castings were eliminated by drilling them out if they were small, and brazing in a plug made to fit the hole. If they were large and in the nature of a crack, and if the crack was wide, a piece of any kind of iron was fitted into the space and brazed into place. If narrow, the crack was cleaned out thoroughly and brazed up. If it was so that it could not be cleaned in this way, the fracture was extended by hammering until the entire break could be reached to clean, even if this involved breaking the piece entirely in two. The cost of the ferrofix involved was about half a cent per square inch of surface brazed.

In tests made for the government in Berlin, at the Stevens' Institute in Hoboken, at the University of California, and by the Pennsylvania Railroad, it had been demonstrated, he said, that the brazed joint was not only stronger than any portion of the casting of equal section, but that the iron adjacent to the joint had its strength increased perceptibly, the tensile strength being raised from 50 to 200 pounds, and the transverse strength as much as 2,000 pounds. It was believed that this was not due to any action of the chemical on the iron, but was entirely owing to the fact that in cooling down from the brazing heat, this cooling down was much more rapid than when the casting was originally made, the effect on the iron being to increase its strength, by reason of this more rapid cooling.

With the practice in Europe in mind, Mr. Ward asserted his belief that the introduction of this brazing process must affect the shop practices as radically as was the case there. As the result of his investigations in Germany, France, and Belgium, Mr. Ward stated that, in his judgment at least 75 per cent of the flaws that ordinarily destroy the value of a casting could be eliminated, and the places made strong and serviceable at a small fraction of the cost of re-molding; and as one of the banes of the foundrymen's business was the loss accruing from the imperfect castings, and this process seemed to solve the trouble to a very large extent, he hoped the gentlemen present would experiment with the process on such lines as they deemed requisite for adding to the knowledge of its use. Several of the gentlemen present asked the privilege of sending imperfect castings to the shops of the American Brazing Company for the purpose of noting the results of the work done. Several small pieces were exhibited, but as there were no means of testing the strength of the joint, it could not be determined just how satisfactory the joints were for strength, although to all appearances the pieces were as sound and strong as if they had been molded perfectly.

Mr. Ward said that the only difficulty encountered in doing large pieces was in cases where the casting was joined in such manner as to prevent free expansion when only a small portion of the casting adjacent to the fracture was heated. As castings of this peculiar character were not as commonly encountered as the other kind, the trouble arising from it was not so serious, he thought, and even in such castings, when the entire piece could be heated more or less, the brazing operation was successful.

"The chief peculiarity of this process of brazing," he continued, "is that it is always perfect when the work is properly done. Its simplicity and cheapness are remarkable in view of the fact that in brazing steel or brass an expert in that art is usually required, in order to insure having a good job, but in ferrofixing by this process no expert skill is required. The alignment of the piece is unchanged, the surfaces, whether machined or not, are not disturbed in any way, and after the completion of the brazing operation all that is necessary is to clean off the surplus brass and the piece will be found as sound and true as a perfect casting."

Mr. Ward stated that several manufacturers in Germany were brazing brass heads on steel bolts where conditions would permit of this being done. Brass was required for appearance's sake and steel for strength. The practice in the German shops, however, is to pay more attention to the looks of a machine than is the practice here. In answer to inquiries made by several of the gentlemen present, Mr. Ward stated that this process of brazing would fasten any two

metals together, excepting possibly aluminium. They had made no experiments in that direction, but meant to take the matter up just as soon as conditions would permit. His company had been so busy arranging for the introduction of the ferrofixing process to the iron trade that no opportunity had been reached that would allow them to make the aluminium experiments, but they expected to try this class of work in the near future as the demand had been made upon them by several manufacturers and there seemed to be a general desire to know how the trials would come out.

MODERN TENDENCIES IN THE UTILIZATION OF POWER.*

By JOHN JOSEPH FLATHER.

IT has been stated that to the construction and perfection of her machinery, more than to any other cause, may be ascribed the present commercial supremacy of the United States.

Be that as it may, the economical production of her manufactures and the convenient adaptations of time and labor saving devices in all the various lines of constructional work have certainly exerted a wonderful influence in the upbuilding of her industries.

Specialization in the manufacture of machine tools and labor-saving devices has followed closely the segregation of processes in other lines of industry, and thus there has been created a multitude of special machines, each designed to perform some single and often very simple operation.

Among other significant features the present tendency in the development and use of this class of machinery is marked by the adaptation of compressed air and the application of electric power to machine driving. In the use of compressed air, the facility of adaptation to various requirements which are in many cases additional to the supply of motive power, is a valuable feature peculiar to this system and one which is susceptible of extension along many lines.

The labor cost in most machine shops and other works is so much greater than the cost of power, that any expedient by which the labor cost may be appreciably reduced is justified, even though the efficiency of the agent itself be low. Whenever new methods or agencies cause an increased production with a given outlay for labor, we shall find these methods superseding the old, even though the cost of the power required be greater than before. The saving of power is a consideration secondary to the advantages and economical output obtained by its use.

While economy in the use of power should therefore be secondary to increased output, yet careful attention to details will often greatly reduce the useless waste of power.

Engineers have recognized for some time past that there is a very great percentage of loss due to shaft friction, which, in railroad and other shops where the buildings are more or less scattered, may be as great as 75 per cent of the total power used. In two cases known to the speaker these losses are 80 and 93 per cent, respectively. In the ordinary machine shop this loss will probably average from 40 to 50 per cent. No matter how well a long line of shafting may have been erected, it soon loses its alignment and the power necessary to rotate it is increased.

In machine shops with a line of main shafting running down the center of a room, connected by short belts with innumerable counter-shafts on either side, often by more than one belt and, as frequently happens, also connected to one or more auxiliary shafts which drive other countershafts, we can see why the power required to drive this shafting should be so large. There is no doubt, however, that a large percentage of the power now spent in overcoming the friction of shafting in ordinary practice could be made available for useful work if much of the present cumbrous lines of shafting were removed.

Manufacturers are realizing the loss of power which ensues from the present system of transmission, and we find a general tendency to introduce different methods by which a part of this loss will be obviated. Among these are the introduction of hollow and lighter shafting, higher speeds and lighter pulleys, roller bearings in shaft hangers, and the total or partial elimination of the shafting.

Independent motors are often employed to drive sections of shafting and isolated machines, and among these we find steam and gas engines, electric motors, compressed air and hydraulic motors, although the latter have not been used for this purpose to any appreciable extent.

In the choice of motors, until quite recently the steam-engine has heretofore been used, especially where the units are relatively large. An interesting example of this is noted in the sugar refinery of Claus Spreckels, in Philadelphia, in which there are some 90 Westinghouse engines about the works, many of them being of 75 and 100 horse power each, others are of 5 and 10 horse power only. A similar subdivided power plant involving 42 engines was erected several years ago at the print works of the Dunnell Company, Pawtucket, R. I.

It was only a comparatively few years ago when several large and economical Corliss engines were replaced at the Baldwin Locomotive Works by a greater number of small, simple expansion engines, which actually required about 15 per cent more steam per horse power hour than the Corliss engines. This loss, however, was only apparent, for by increasing the number of units and locating them at convenient centers of distribution, much of the shafting and belting could be dispensed with and an actual saving was obtained. Later, these simple engines were replaced by a number of compounds, some eighteen being in service; subsequent tests on these showed a saving of 36 per cent over that obtained by the use of the simple engines.

More recently, however, the electric motor has superseded the steam-engine for this work, as its economy and convenience over the latter are now thoroughly recognized.

The statistics of American manufacturing compiled by Mr. T. C. Martin for the United States Census Office, show that at the time of the last census, in 1900, electric power was less than five per cent of all that was in use in such plants, or about 500,000 horse power out of a total of 11,000,000; but, as Mr. Martin states, things are to be judged by tendencies rather than by the *status quo*, and these electric motor figures exhibit an increase of 1,900 per cent during the decade.

The introduction of the electric motor in machine shops and factories was at first looked upon with disfavor and was opposed by many manufacturers, but the innovation obtained a foothold, and advantages which were at first unforeseen were found to attend its use, so that now it is being very generally adopted for a wide variety of work.

A considerable difference of opinion exists as to whether individual motors should be used with each machine, or whether a number of machines should be arranged in a group and driven from a short line shaft.

There are well-defined conditions to which each system is best adapted, but there are wide limits between which there appears to be no general rule, and we find both methods occupying the same field.

For isolated machines and for heavy machines that may be in occasional use, the individual motor is particularly well adapted, as it consumes power only when in operation. It is, however, necessary that each motor thus connected shall be capable of supplying sufficient power to operate its machine under the heaviest as well as lightest loads. In certain cases, moreover, the load is liable to very great irregularity, as for instance in metal-working planers, in which the resistance offered by the machine at the moment of reversal of the platen is far higher than at other times, and may be so great as to endanger the armature of the motor. Under these conditions it is necessary to use a motor of much larger capacity than the average load would indicate.

Fortunately with electric motors the rated capacity is usually less than the safe maximum load, which is determined either by the heating of the conductors, tending to break down the insulation, or by excessive sparking at the brushes. For momentary overloads relatively large currents may pass through the coils without injury to the insulation, since the temperature effect is cumulative and requires time for its operation. However for continuous periods of considerable length it is usually unsafe to operate the motor much above its rated output.

Ordinarily in machine-driving the motor is shunt-wound, and the current through the field-coils is constant under all conditions of load; but to obtain the best results with that class of machinery in which the load is intermittent and subject to sudden variations, the motor should be compound-wound so as to increase the torque without an excessive increase of current in the armature.

In many cases with individual motors, owing to wide variations in power required, the average efficiency of the motor may be very low; for this reason a careful consideration of the conditions governing each case indicates that for ordinary machine-driving, especially with small machines, short lengths of light shafting may be frequently employed to good advantage, and the various machines, arranged in groups, may be driven from one motor. By this method fewer motors are required, and each may be so proportioned to the average load that it may run most of the time at its maximum efficiency.

When short lengths of shafting are employed, the alignment of any section is very little affected by local settling of beams or columns, and since a relatively small amount of power is transmitted by each section, the shaft may be reduced in size, thus decreasing the friction loss. Moreover, with this arrangement, as also with the independent motor, the machinery may often be placed to better advantage in order to suit a given process of manufacture; shafts may be placed at any angle without the usual complicated and often unsatisfactory devices, and a setting-up room may be provided in any suitable location as required, without carrying long lines of shafting through space. This is an important consideration, for not only is the running expense reduced thereby, but the clear head-room thus obtained, free from shafting, belts, ropes, pulleys and other transmitting devices, can be more easily utilized for hoists and cranes, which have so largely come to be recognized as essential to economical manufacture.

In arranging such a system of power distribution the average power required to drive is of as much importance as the maximum, for in a properly arranged group system the motor capacity need not be the equivalent of the total maximum power required to operate the several machines in the group, but may be taken at some value less than the total, depending upon the number of the machines and the average period of operation. On the other hand as already shown, the motor capacity of independently driven machines must not only equal the maximum power required to drive the machine at full load, but it must be capable of exerting a greatly increased momentary torque. In any case large units should be avoided, for the multiplication of machines driven from one motor entails additional shafting, countershafts and belting which may readily cause the transmission losses to be greater than those obtained with engines and shafting alone, besides frustrating some of the principal objects of this method of transmission.

As far as the efficiency of transmission is concerned, it is doubtful whether, in a large number of cases, motor-driving *per se* is any more efficient than well-arranged engines and shafting.

As already pointed out, the principal thing to be kept in mind is a desired increase in efficiency of the shop plant in turning out product, with a reduction in the time and labor items, without especial reference to the fuel items involved in the power production.

On account of the subdivision of power which results from the use of many motors, there is less liability of interruption to manufacture, and in case of overtime it is not necessary to operate the whole works, with its usual heavy load of transmitting machinery.

Another advantage is the adaptability to changes and extensions; new motors may always be added without affecting any already in operation, and the ease with which this system lends itself to varying the speed of different unit groups is a very potent factor in its favor.

One serious obstacle to the use of connected motors with machine tools is the difficulty of obtaining speed variation, which is so necessary with a large proportion of the machines in common use. A certain amount of variation can be obtained by rheostatic control—a wasteful method; or by using a single voltage system with shunt field regulation; but the variation in either case is very limited. This, however, may be increased by using a double commutator if space will permit.

The three-wire, 220-volt system offers many advantages for both power and lighting systems, and is very frequently employed. Variations of speed may be obtained with this system by using a combination of field regulation with either voltage, and, in rarer cases, the use of a double commutator motor.

A method which has been used recently with considerable satisfaction involves the use of a three-wire generator, with collector rings connected to armature winding similar to that of a two-phase rotary converter. Balancing coils are used, and the middle points of these are connected to the third wire, which is thus maintained at a voltage half-way between the outer wires. This system is simple and economical, and possesses all the advantages of the ordinary three-wire method; it permits similar variations in speed by field regulation with either voltage; and if still wider ranges are desired a double commutator motor may also be used.

In other recent installations the four-wire multiple voltage system is used, which permits of very wide variations of speed in the operation of the tool. This system gives excellent results and removes one of the objections urged against direct-connected motor-driven tools, namely, that such machines are not sufficiently flexible in regard to speed variation, and that such variation can only be obtained by throwing in resistances which cut down the efficiency of the motor, or by varying the strength of field which reduces the torque.

The multiple voltage system, however, has some serious disadvantages. It can not usually be operated from an outside source of power without rotary transformers; the generating sets and switch-board are complicated and the total cost of installation is expensive; yet with these drawbacks the system is growing in favor, as it has manifest advantages which outweigh the objections.

The storage battery has been used to some extent to obtain multiple control and is suggestive of interesting possibilities, but in its present form it is not altogether desirable for machine tools.

In many of the larger sizes of certain metal-cutting machines it is probable that marked changes will be produced in the immediate future, and the indications are that direct-connected motors with wide variations of speed and power will be incorporated in the new designs.

The recent improvements in the manufacture of certain grades of tool steel have shown indisputably that the present designs of machine tools are not sufficiently heavy to stand up to the work in order to obtain the economy of operation which results from the use of such steels. Higher speeds, heavier cuts and greater feeds may be obtained if the machines will stand the strain, but in most cases the capacity of the machine is not commensurate with the ability of the tool to remove metal. With cutting speeds of 100 to 200 feet per minute, it is evident that the power requirements will be much greater than for the ordinary machines of to-day, which have a cutting speed of from 10 to 30 feet per minute. As an illustration of what can be done with these new tool steels the speaker was recently shown some steel locomotive driving-wheels which had been turned up in two hours and forty minutes, whereas the regular time formerly required was not less than eight hours. In this case even better results could have been obtained, but the belts would not carry the load.

Here then we find an interesting field for the direct-connected motor with ample power and speed variation for any work which it may be called upon to perform.

While the preference is easily given to continuous-current motors for the purposes of machine driving, yet we find alternating current motors used to a considerable extent, the proportion of motors in service being about one to five in favor of the continuous-current motor. Both synchronous and induction motors are employed, but the advantages possessed by the latter cause this type to be preferred, although in long-distance transmissions, both types should be used in order to obtain satisfactory regulation. As shown by Mr. H. S. Meyer,* the induction motor can readily be worked at variable speeds, which is accomplished in three different ways: (1) by rheostatic control, which is decidedly the cheapest and easiest method to manipulate; (2) by varying the impressed voltage, which, however, necessitates the use of a transformer or compensator with variable ratio; this is very inefficient at the lower speeds and can only be used under certain conditions; and (3) by altering the number of poles, which is mechanically very complicated, but where the speed variation is only one-half or one-quarter it may be used efficiently.

One serious disadvantage met with in all induction motors is the lag produced by self-induction, and its reaction on the circuit. This lag is particularly unsatisfactory with intermittent service, such as machine driving, where the motors have to run under light and variable loads; in such cases the power factor is probably not over 60 or 70 per cent.

Reference has been made to the use of compressed air and its facility of adaptation to various requirements, but it is evident from an inspection of some of the devices in use that enthusiasm for new methods, rather than good judgment, has controlled in many of its applications.

For some years compressed air was used only in mines, where it produced marked economies in underground work. Later, compressed air was introduced into manufacturing lines, and to-day its use in railroad and other machine shops, boiler shops, foundries and bridge works is being widely extended. In the

* Address of the chairman of Section D, Engineering and Mechanical Science, and vice-president of the American Association for the Advancement of Science. Read at the Washington meeting, December 29, 1902.

* London Engineering, April 19, 1901.

Santa Fe Railroad shops at Topeka there are over five miles of pipe in which compressed air is carried to the different machines and labor-saving appliances throughout the works.

In such shops air is used to operate riveting machines, punches, stay-bolt breakers, stay-bolt cutters, rotary tapping and drilling machines, flue rollers, rotary grinders, rotary saw for sawing car roofs, pneumatic hammers, chisels and caulking tools, flue welders, boring and valve-facing machines, rail saws, machine for revolving driving-wheels for setting valves, pneumatic painting and whitewashing machines, dusters for car seats and the operation of switching engines about the yard. It is also used in the foundry for pressing and ramming molds, and for cleaning castings by the sand blast; but its greatest field of usefulness is its application to hoisting and lifting operations in and about the works.

New applications of compressed air are constantly being made, and each new use suggests another. This has a tendency to increase the number of appliances which are intended to be labor-saving devices, but in many cases the work could be done just as well and much more cheaply by hand.

A case in point is seen in an apparatus which was at one time in use on one of our prominent western roads. It was a sort of portable crane hoist which could be fastened to the smoke-stack of a locomotive, whereby one man could lift off the steam chest casing. The hoisting apparatus weighed about twice as much as the steam chest and took three men to put it up. When piece work was adopted two men easily lifted off the steam chest and this "time and labor-saving device" was relegated to the scrap heap.

While compressed air has been used to some extent for inducing draft in forge fires, it is unquestionably a very expensive method. Tests to determine this show that it costs twenty-five times as much to produce blast in that way as it would with a fan.*

The success and economy which has attended the use of compressed air in so many lines of work has led to its adoption in fields which are much better covered by electrically operated machines. While compressed air has been used under certain conditions very satisfactorily to operate pumps and engines, printing-presses, individual motors for lathes, planers, slotters, dynamos, and other work, it does not follow that it is always an economical agent under these various uses, or that other methods could not be used even more satisfactorily in the majority of cases.

It has been proposed to use individual air motors in machine shops and do away with all line shafting, except possibly for some of the heavier machinery. This use of compressed air seems entirely outside the pale of its legitimate field; the general experience thus far indicates that rotary motors are not at all economical and generally are not as satisfactory as electric motors.

Exceptions are to be found in the small portable motors for drilling and similar operations to which electricity is not at all adapted and where compressed air has been found to give excellent results. The saving obtained by the use of such portable drills as compared with a ratchet drill is very marked.

Although these tools are very successful they are still rotary motors, not exempt from some of the objectionable features which seem to be inseparable from them. It is not surprising, therefore, to find a tendency to employ reciprocating pistons and cranks in these portable machines and we note such tools weighing only forty pounds capable of drilling up to two and a half inches diameter.

While the field is to some extent limited, yet the uses of compressed air are certainly not few, and in many lines of work marked economy results from its use.

In most cases no attempt has been made to use the air efficiently; its great convenience and the economy produced by its displacement of hand labor have, until recently, been accepted as sufficient, and greater economies have not been sought.

In the matter of compression we still occasionally find very inefficient pumps in use, but manufacturers generally have found that it pays to use high-grade economical compressors. The greatest loss is that in the air motor itself. In a large number of cases it is impracticable or, at most, inconvenient to employ reheaters, and we find very generally that the air is used at normal temperature for the various purposes to which it is applied.

To obtain the most satisfactory results the air must be used expansively, but usually where the demand for power is intermittent no attempt has been made to reheat the air, and as a result the combined efficiency of compressor and motor is quite low, varying in general from 20 to 50 per cent. While low working pressures are more efficient than high, the use of such pressures would demand larger and heavier motors and other apparatus which is undesirable.

The advantages of higher pressures in reducing cost of transmission are also well recognized, and the present tendency is to use air at 100 to 150 pounds instead of the 60 or 70 pounds of a few years ago.

By reheating the air to a temperature of about 300 deg. F., which may often be accomplished at small expense, the efficiency is greatly increased; in some cases this has been shown to be as high as 80 per cent. While the lower pressures are yet more efficient, the loss due to higher compression is not serious.

If air be used without expansion it will be seen that there is a material loss in efficiency; but, on the other hand, if it be used expansively without reheating, trouble may be experienced, due to the drop in temperature below the freezing point. If moisture be present this will cause the formation of ice, which may clog the passages if proper precautions are not taken to prevent it. The low temperature will not in itself cause trouble; if, therefore, the moisture which the compressed air holds in suspension be allowed to settle in a receiving tank, placed near the motor or other air apparatus and frequently drained, less trouble will be experienced from this cause.

While it may be impracticable to reheat the air in certain cases, yet there are many situations where a study of means to overcome the losses referred to would result in marked economies.

The greater adaptability of compressed air to various purposes causes its use to increase along with that of the electric motor, for it has a different field of usefulness, independent of power transmission; at the same time when the requirements are properly observed in its production and use, its economy as a motive power in special cases compares favorably with other systems. With a better knowledge of the principles involved we may expect much better results than have yet been attained.

But compressed air possesses so many advantages that, however inefficient it may be as a motive power, its application to shop processes will be continually extended as its usefulness becomes better known.

(To be continued.)

* Proc. Western Ry. Club, 1898.

THE WESTINGHOUSE ELECTRO-PNEUMATIC SYSTEM OF TRAIN CONTROL FOR THE BROOKLYN ELEVATED RAILWAY.

A FEW years ago the management of the Brooklyn Elevated Railway Company decided to discard steam locomotives and to operate all trains electrically. Before making such a wholesale change, however, it was deemed prudent to test exhaustively the different methods of handling electric trains. If the steam locomotive were to be replaced by simple electric locomotives, many of the advantages of electric traction would be sacrificed. In order to reduce the dead-weight hauled and to obtain a higher tractive effort when starting, it is better to place the driving motors on the trucks of several of the passenger cars of a train and thus take advantage of the weight of the cars than to put the motors on a locomotive, which must be artificially loaded down to give it the necessary adhesion. Other reasons for choosing a system employing a number of motor cars per train rather than a single locomotive were that, since the service is fluctuating, during a part of the day the large motors of the locomotive would be operated at a light load and consequently low efficiency. Moreover, the trains could not be broken up into single units, as is possible when a number of the cars carry their own motor equipments.

The Brooklyn Elevated Company, therefore, went to the leading electrical manufacturers who had developed systems for controlling a number of motor cars in a train, and asked them each to equip a number of model trains for testing purposes. These trains were placed on the Brooklyn road a few years ago, and have since operated in the regular daily traffic. The companies furnishing equipments were the Westinghouse Electric and Manufacturing Company, of Pittsburg, the General Electric Company, of Schenectady, N. Y., and the Sprague Electric Company, of New York city. Careful records were kept of the number of miles run by each train, the number of accidents met with, the cost and time required for repairs, the comparative convenience in operation, and all other matters that might influence the decision. The result of this investigation has been the placing of the order mentioned above. All steam locomotives now in use will be in a short time replaced, and trains will be operated by the Westinghouse system. In addition to the order for 210 cars, the company has already purchased about 150 equipments, which have been in satisfactory operation for nearly a year.

The Westinghouse multiple train control system has been developed by Mr. George Westinghouse, and, on account of his long experience in railroad and electrical matters, is eminently adapted for the operation of trains under everyday railway conditions. The Westinghouse system involves the use of compressed air for moving the current-controlling apparatus, electromagnetic valves governing the admission of air to the controlling cylinders and low-voltage electric circuits running from car to car for controlling the action of the magnet valves. The connections for the low-voltage circuits are the only ones which have to be established between the cars of the train, no air connections being required outside of the ordinary brake hose. A complete equipment for each motor car consists of two or four electric motors, a controller very similar to the controllers used on ordinary street cars, and one or two motormen's controlling switches, from any one of which all the car controllers on the train may be operated. The car controller, as stated, is similar in design to the ordinary form of hand controller which has been successfully used on electric street cars for many years. It consists essentially of two drums which revolve in bearings, and stationary contact fingers which make contact with points upon the revolving drums. The large or main drum opens the main circuit and makes the motor and resistance combinations; the small drum reverses the motors. A multiple control switch is placed at one or both ends of each motor car and by means of the one at the front of the leading car the motorman controls the action of the controllers on all of the motor cars in the train. Some of the points of superiority of this system over other systems may be stated as follows:

It employs compressed air for operating the control apparatus, and thereby uses a powerful and reliable agency. It uses the standard type of controller and standard types of valves and magnets, the latter having been used for years in the operation of the Westinghouse electro-pneumatic system of switches and signals upon the largest railways in the world. It is the only system in which the control circuit is isolated from the main power circuit. The control circuit is, therefore, not affected by a momentary interruption of current due to ice and sleet on the rails, or other causes. With the low-voltage current, grounds and short circuits at the connectors between the cars during stormy weather or fires resulting from high-voltage circuits through the train are entirely eliminated. The current for the motors is simply collected from the third rail, led through the local car-controlling apparatus to the motors, and then back to the service rails, and does not pass from car to car. The controlling apparatus is so located that the motorman may have convenient access to all parts from the platform.

The motor circuits on any car are automatically opened in case of excess current, and they can all be simultaneously closed at the will of the motorman. All controllers are automatically turned off by the application of the automatic air brakes, which is an important point, since in case of a train breaking in two, the brakes are automatically applied and at the same time the power is shut off. With other systems under some circumstances, it has been found impossible to shut off the power from some of the cars, while in the Westinghouse system there are a number of ways in which this may be accomplished, greatly reducing the possibility of accident. Both controllers and circuit breakers are opened by a breaking in two of the train, this action being independent of and in addition to the effects obtained by the application of the air brake. The controllers may be operated by hand, thus permitting the train to run to a terminal station in case of any derangement of the controlling apparatus. The operation of both brakes and controllers is effected by a single air-hose connection between the cars, the air compressor which furnishes air for the brakes also furnishing air used to operate the controllers.

The Brooklyn Elevated will equip all its new cars with four motors each. The 150 cars now in use equipped with the Westinghouse system have each two motors. The trains on the road are made up of five or six cars, two or three of which are usually motor cars. When these trains reach the suburbs they are broken up into smaller units of one or two cars, each of course containing a motor car, and the smaller trains branch off on different divisions. By the use of this system it is possible to operate cars individually as on ordinary trolley roads, or to make them up into trains of any length. Also, any proportion of motor cars may be used, making it possible to obtain any desired amount of power for starting the trains quickly, which is necessary in any service involving many stops.

The significance of the investigation into the different systems of train control which has been carried on by the Brooklyn Elevated will be appreciated when it is remembered that the Rapid Transit Subway in New York will be operated by electricity, and since its trains must be operated at high speed, some system of multiple train control will have to be adopted. There is also the Pennsylvania tunnel system under New York, which the ordinance recently passed by the Board of Aldermen requires must be operated by electricity or some other agency not involving the burning of fuel in the tunnel.

A TROLLEY ROAD IN KOREA.

IT was in the autumn of 1898 that the first sod was turned for the building of the first street railway of Korea, and in the early part of May of the following year an official opening took place, a car was run over the road and the success of the enterprise, so far as the construction and operation were concerned, seemed assured. The cars were run by Japanese motormen and native conductors, and for a week all went well. The cars were crowded from morning until night, and for the first time perhaps in the history of Korea the inhabitants of Seoul had some means of enjoying themselves.

At the end of the week, a child standing one afternoon near the track was beckoned by its father. Not thinking of danger, it ran in front of a rapidly moving car and was crushed to death. Instantly the superstition of the people was aroused; the foreign "devils" had introduced something among them from which nothing but ruin would follow; the traditions of their country were disrespected, and the calmness that had been with them for centuries was now visibly disturbed by this innovation. Within a few minutes after the fatal accident, therefore, the cars were attacked, and in a short time two were completely destroyed by fire. A rush was then made toward the power house, with the view of demolishing that structure, for it was conceded by all that it was built on the rain dragon's back, which accounted for the severe draught that prevailed that season. Fortunately, however, they were prevented from carrying out their plans in this direction by the presence of two of the foreign railway officials and a handful of imperial guards.

Immediately after this episode the running of the road was discontinued, the management concluding that, for a short time at least, foreigners would have to take entire charge of the plant, in order to insure the success of the enterprise. Late in the summer of 1899, therefore, the road was again put in service with American operatives, and has since continued at work uninterruptedly up to the present time. Accidents have occurred, occasionally followed by slight demonstrations of the people, but the antipathy is slowly giving way, and the railway is beginning to be looked upon as a necessity. The road is about nine miles long, with a 3 foot 6 inch gage, single track and turn-outs at intervals of 3,000 feet, the cars being run at intervals of 12 minutes.

The cars are built at Seoul from plans of American cars, with slight modifications to suit the conditions prevailing in Korea. A closed section in the center accomodates the first-class passengers, while each end is open and has seats running lengthwise. Twelve of these cars run from 7:30 A. M. until 11:20 P. M., and are well patronized by the people, especially in the hot summer evenings, at which time the service is barely sufficient to meet the demands.—R. A. McLellan, in Cassier's Magazine.

Absorption of Projected Electrons.—It is well known that the absorption of cathode rays by thin metallic plates decreases when the discharge potential —i.e., the velocity of the projected electrons—is increased. W. Seitz has studied the quantitative relation between absorption and discharge potential, and declares that the coefficient of absorption is inversely proportional to the fifth power of the velocity, or the 5-2 power of the difference of potential. This law would mean that the penetrative power of projected electrons is enhanced 243 times by increasing their velocity three times. The investigation required the knowledge of the discharge potential, the number of electrons passing through the Lenard window, and the

number of electrons absorbed by it. The potential was obtained from an electrometer attached to the cathode. The cathode rays absorbed by the window were measured by means of a galvanometer connected with it, and those penetrating the window were caught in a metallic box connected with a second sensitive electrometer, which served to measure the unabsorbed rays. The voltage employed ranged from 13,200 to 15,800. The author intends to extend the range of potentials. The window used was a piece of aluminium foil 0.00032 cm. thick, attached to a platinum tube by Wien's method.—W. Seitz, Physikal. Zeitschr., September 1, 1902.

THE DIVERSITY OF USES FOR COLD STORAGE.*

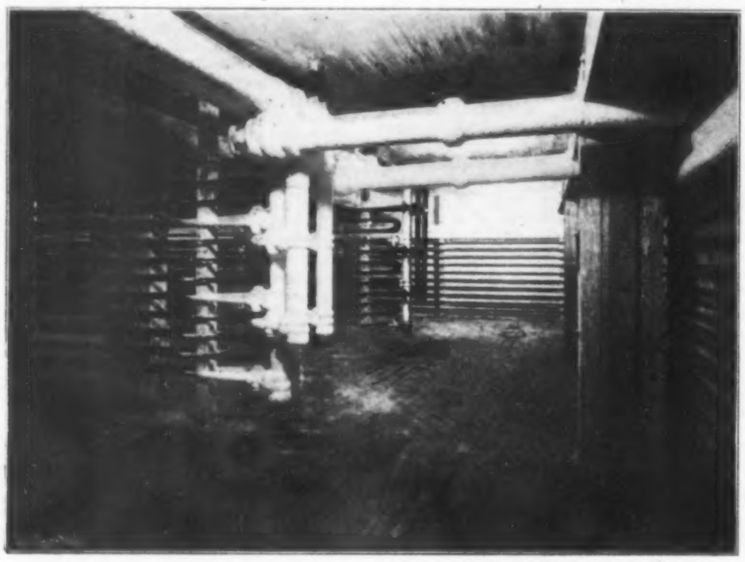
By DAY ALLEN WILLEY.

THE use of cold air has become so extensive and varied within a comparatively short period that the general reader probably has little conception of the vast amount produced yearly in this country alone. In fact, refrigeration is popularly termed ice making, and not a few believe that articles are generally preserved by the employment of ice formed naturally or by mechanical processes. The truth is, however, that the area of "cold storage" kept at a certain temperature by the frozen liquid is so small as to be insignificant when contrasted with the service performed by ammonia and other substitutes for ice in reducing the temperature, although what would be called enormous quantities of the latter are still utilized in connection with certain lines of industry.

It is questionable whether any product has come into common use more rapidly than air thus treated, unless it be electricity or steam. It is now indispensable in connection with some of the largest business enterprises, which, without it, would soon cease to exist. As an instance of its necessity in connection with the preservation of food, it may be stated that, although the first cargo of 400 carcasses thus preserved was received by the English marketmen but twelve years ago, at the present time over one-third of the entire quantity of meat consumed in Great Britain alone is shipped to that country "chilled," not only from the United States but South America, Australia, and northern Europe. It is estimated that 175 vessels, each having a cold storage capacity ranging from 1,000 to 10,000 carcasses, are plying on the Atlantic alone. Dairy products and vegetables from Norway, Sweden, and Denmark, fruit from southern Europe, fish from New Zealand and Alaska, are carried to the British consumer in perfect condition, thanks to the same system, while thousands of tons of the harvest from orchards and gardens of the Pacific coast also are sold in the same market side by side with apples from the Eastern States. Probably the menu of the Englishman has been doubled in variety merely by the use of refrigeration processes.

The extensive systems employed in breweries, provision depots, dairies, and distilleries have familiarized Americans with the use of cold air; but it has become such a public necessity that no modern hotel or apartment house on a large scale is constructed without a plant for producing it by some process. It is as much a portion of the mechanical equipment as the elevator motor, or the lighting and heating apparatus. It is also being introduced for cooling purposes in theater and other auditoriums; it maintains a pleasant temperature during the heated term in the hospital ward, and several companies have been formed to distribute it in cities through mains, as water and gas are supplied to the consumer. In some of the largest packing houses of Kansas City and Chicago, not a pound of ice is used in a year for preservative purposes, although every department where the products of the beef, sheep, and hog are stored any length of time, are required to be at a temperature near or below the freezing point. The industries referred to, however, represent only a portion of those utilizing cold air in some process. Plants are now being made in this country to generate it for butter factories, butterine factories, ice cream factories, chemical works, sugar refineries, molasses factories, paraffine works, oil refineries, stearine factories, chocolate factories, morgues, office buildings, skating rinks, steel-tempering plants, blast furnaces, laundries, glue works, dry-plate works, dynamite works, paint factories, soap factories, fur storage, India-rubber works and plants for seasoning lumber. As will be noted, the list includes some of the most important American industries.

While an extensive variety of machinery is being manufactured for refrigeration under a score of patents, the aim of all the inventors is the same—to perfect the most economical process to remove the heat from a certain temperature level to a higher level, discharging it at this point. When it is stated that with one ton of coal, a cold air equivalent of from 8 to 14 tons of ice has been produced, the quantity varying according to the process employed, an idea can be given of the economy of the apparatus at present in use. In the United States the refrigerating machines use anhydrous ammonia as the agent for generating low temperatures, mostly in conjunction with brine made from chloride of calcium and water. The ammonia is circulated through a series of pipes in which it evaporates. Then, in its gaseous form, it is pumped by the machine into the condensers and liquefied. In this manner the property of ammonia to take up over 500 thermal units in changing from the liquid to the gaseous state is made use of. The brine cooler consists of a double pipe coil. A small quantity of ammonia is injected through a needle valve, which allows a very fine stream to pass into the space between two pipes, running in a coil approximately 300 feet long surrounding a pipe containing the brine above mentioned. From this coil the ammonia gas is drawn to the machine. The gas is forced thence into other coils, called the ammonia condensers, which have water circulating over them. It is now in a heated condition from the compression. The water running over these coils cools off the gas, and at the same time condenses it, as gas at the ordinary temperature of water—between 50 deg. and 90 deg. F.—is converted into liquid anhydrous ammonia by a pressure of from 150 to 200 pounds. In this form the ammonia is conducted to a receiving tank, and from there it again passes through the needle valve into the brine cooler, going through the same circuit again and again.



PIPING IN FREEZING AND COLD STORAGE COMPARTMENT.

The brine cooler represents the apparatus where the brine and ammonia systems are in conjunction, the brine being pumped through the cooler, and from there through coils of pipe in the room in which it is desired to reduce the temperatures. This is sometimes to 20 deg F. below zero for freezing fish, sometimes to 32 deg. F. for preserving meat, and often to 50 deg. F. only for preserving fruits and other perishables. The temperature is easily adjusted to the required degree by controlling the brine flow in the piping. By lessening or increasing the flow in a single pipe, a wide range of temperature can be produced. Thus the same room can be used either for freezing the articles it contains, or merely for chilling them.

The capacity of a refrigerating machine is based upon the weight of ammonia in the gaseous form which it can discharge in twenty-four hours, each pound of gas representing a certain quantity of heat-absorbing power. The unit of capacity is the refrigeration which would be accomplished by the use of one ton of ice. Such a quantity will lower the temperature of 28,400 pounds of water ten degrees. Therefore, if a "one-ton" machine is employed, it will cool 197 1-5 pounds of water to the extent of one degree a minute. Tests made of the York type machines of this capacity show that one will keep the "curing" department of a packing house containing 12,000 cubic feet of space at a temperature of 40 deg., or 1,500 cubic feet at zero. In other words, it is sufficient to keep 10 beeves or 25 hogs chilled at the former temperature. As a single plant used in the large packing houses and breweries may represent 500 tons capacity, it will be seen that the cold storage compartments are maintained on a very elaborate scale, a single one containing thousands of carcasses. The horse power required for one of these large machines aggregates 625. The air compressors are built in various designs, and are known as single and double acting.

The manner in which the pipes are arranged can be seen in the photographs. In large cold-storage warehouses the floors are not over 8 or 9 feet in height. The pipe is attached to the walls, and in wide rooms, to the sides of posts running through the middle of the room, so that an equal temperature can be maintained in all portions. In others, like fish-freezing rooms, the pipes are even used as shelves to hold the tins filled with fish, which are frozen into bricks and piled away in another compartment. Poultry and game are also kept in a frozen state, and the meat remains almost as hard as stone while in the cold room. Butter also is kept at a temperature near zero, which is said to preserve the flavor contained in its volatile oil so that it is equal to fresh butter. Eggs are preserved sometimes from two to six months, but require particular care. The air in the room should be neither too moist nor too dry, and the chamber should be neither without ventilation nor supplied with too much, as then the eggs would lose in weight on account of their liability to evaporate through the shell. Eggs, butter, and milk are also liable to be tainted by any smell arising from the woodwork, or articles stored in the neighborhood, and the rooms have to be constructed and arranged with this point in view.

The above, it may be said, have been problems for the cold storage experts to solve by practical experiments; but food products can be preserved in properly constructed houses with as little difficulty as any other articles.

In the preservation of meat, from the time that the beef, sheep, or hog is killed, it is kept in cold storage or "chill" rooms, until the time that it is taken from the refrigerator to be prepared for the table. The "chill" rooms are used to take the animal heat out of the meat, and reduce its temperature from about 98 deg. F. to cold storage temperature, i. e., from 32 deg. to 40 deg. F. For this purpose the meat is hung on rails in rooms which have chambers in the upper part over the rails for ammonia or brine piping, which reduces the temperature to a point near freezing before the meat is put in. After the meat is put in, the animal heat it still contains raises the temperature in the room, but this is again gradually lowered, in the course of 24 to 48 hours, to the proper degree for refrigeration. This length of time is required in order to chill the meat thoroughly. Should it become chilled on the outside and remain warm in the center, the center part of the meat would be spoiled.

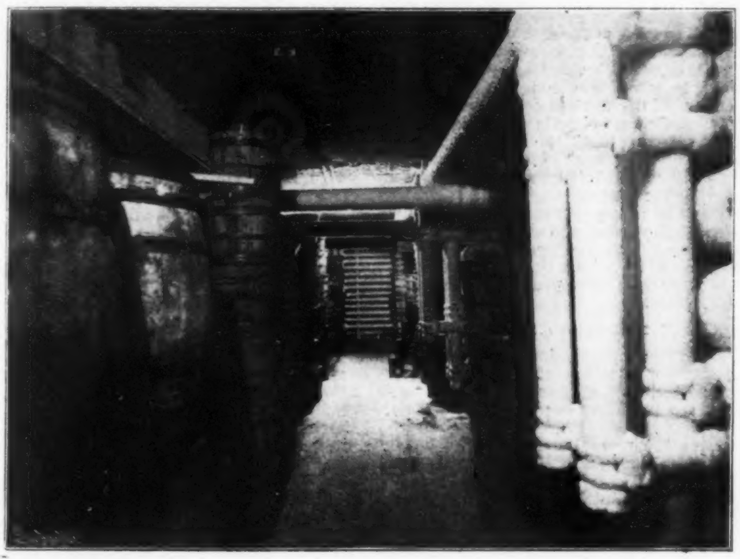
From the "chill" room the meat is run into the cold storage rooms and hung on rails, where it is kept until such time as it is to be shipped. The choicest pieces are kept at least four weeks in cold storage, as the quality is thus improved, and, if the rooms are kept clean, these pieces will taste better than meat which has been recently slaughtered. For this reason, not only slaughter houses, but depots of packers and other buildings where meat is kept in cold storage, even to small butcher establishments, are preferably cooled by refrigerating machinery, owing to its dryness and cleanliness.

In some of the large hotels refrigerators cooled by machinery are even placed close to the ovens or ranges

COLD STORAGE OF FURS TO PREVENT ATTACK BY MOTHS.

* Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.

where the viands are prepared for consumption, the refrigeration being maintained at the proper standard despite the outside temperature. High temperature is also the rule in candy factories, but manufacturers of chocolate candy have been using refrigerating machines for some time. They are forced to do this, as the compound is apt to become soft in hot weather, which, of course, would spoil the appearance of the goods for the market. The arrangement of the refrigerating piping for chocolate factories has been made in various ways. In some instances a large refrigerator is cooled in the center of the working room with the piping inside of it, this refrigerator being of such length that endless belting carrying tins with chocolate enters it on one side and brings them out chilled on the other. In other workrooms a series of pipe coils are simply placed along the ceiling, and the cold air coming down chills the confectionery as it is made by the employes in the same room. The chocolate is then stored in refrigerators, apart from the workroom, and there properly packed at a low temperature. After being packed it can be sent out, and ordinarily will keep for an indefinite length of time.



BARRELS OF PERISHABLE FOOD AND TUBS OF BUTTER IN A COLD STORAGE COMPARTMENT.

One of the most interesting applications of cold storage, however, and one which has become very extensive, is preserving furs and woolens, which are kept at a temperature of not over 20 deg. F. to keep the moths from destroying them. These rooms have a very interesting appearance, as among the trunks, boxes, and drawers of clothing there appear figures of bears, tigers, and all other kinds of stuffed animals in threatening attitudes, put away through the hot season by their owners and taken out in the fall. Sometimes furs are left in storage continuously for several years, yet at the end of the time they are invariably found in perfect condition. Many of the trust companies in the larger cities have such cold storage compartments. In these fur and clothing rooms, where valuable carpets and rugs are also stored, the air is generally cooled outside of the room and circulated through it by means of fans.

THE LEATHER GLOVE INDUSTRY IN THE UNITED STATES.*

THE manufacture of leather gloves and mittens is now for the first time made the subject of a special report by the United States Census Office, although the industry has been of commercial importance in the country for nearly a century. In 1900, there was a capital of £1,825,000 invested in the manufacture of leather gloves and mittens in the 397 establishments in the United States. This sum represents the value of land, buildings, machinery, tools and implements, raw material, etc., but does not include the capital stock of any of the manufacturing corporations engaged in this industry. The value of the products is returned as £3,409,999, an increase of 68.7 per cent in the period 1890-1900.

The manufacture of gloves in the United States dates from about the year 1760, when Sir William Johnson, chief agent of King George with the North American Indians, brought over from Scotland many families as settlers on his grants. Many of these settlers had been glove makers and members of the Glove Guild of Scotland, and brought with them glove patterns and proper needles and threads for glove making. The first gloves and mittens were used chiefly by the farmers' and woodchoppers as a protection for the hands when engaged in the rough and laborious work incident to their occupation. The industry received a decided stimulus during the civil war, as large quantities of gloves, especially gauntlets, were required for military service. During the early period of the industry the Indian process of tanning was exclusively employed. The distinguishing feature of this process was the use of the brain of the deer, which insured a durable, as well as a soft and pliant leather. Somewhat later an attempt was made to substitute the brain of the hog, but the results were not entirely satisfactory, as it lacked certain essential properties possessed by the deer brain.

At the present time the sheep and lamb skins used are received in what is termed "salt pickle," which is applied to the skin after the removal of the hair. As soon as received they are thoroughly washed, to remove the salt and to extract the pickle, after which they remain in an alum bath for nearly twelve hours. They are then staked, a process which involves the stretching or drawing of the skin over a thin, round-faced iron attached to a piece of wood about the height of a man's knee. This is done partly by the hand and partly by the knee of the operator. The process is generally termed "knee staking," in contradistinction to a similar process known as "arm staking," to which the leather is subjected after reaching the glove factory. The skins are then dried in the open air or in drying rooms, the temperature of which is regulated according to the nature of the skin and the time required to dry it, after which they are again carefully washed, slaked, and dried. As a rule the skins are next sorted according to size and quality, and are then submerged in an egg bath consisting of a preparation of ten parts of salt with ninety parts of egg yolk. By revolving the skins in a drum the egg yolk is thoroughly absorbed, and the leather becomes soft and pliable. They are next colored by placing them flesh side down on zinc or lead tables, and applying the color with a brush. After the color is set and the skins are thoroughly dried, they are dampened, rolled up in bundles, flesh side out, and stored away to season for a varying length of time. The milling of oil-dressed skins involves a somewhat different process. After the skins are soaked in vats they are scraped to remove the grain, then dried into parchment, soaked in water and milled in oil. The oil and natural grease are removed by the agency of soda ash, the skins being repeatedly dried during these various processes, after which they are subjected to the braking machine, and then staked with a blunt tool, which renders them pliable. They are then put on the "buck tail," or emery wheel, and cut down for a face, and then returned to the water for a clean scouring, wrung out and dried, spread upon the grass for the night dew to bleach, and again staked, finished and smoked or colored, after which they are ready for the glove maker. As soon as the skin is received by the glove maker it is immediately staked by the hand stake, which consists of two upright and two horizontal bars, one of the latter being movable to admit the skin, which is held in position by a wedge inserted at the end of the bar. The stretching is then done by pressing over the skin so placed a blunt iron like a spade, having round corners and a handle which fits under the arm. The oil-dressed skins are then split even in a belt-splitting machine, and the kid skins are shaved either by "mooning," or by placing them on a marble slab, with the flesh side up, and shaving the surface with a broad chisel, or so-called "dowling-knife." By this process the skin is reduced to the desired thinness, and the inequalities of the flesh side are removed. "Mooning" is performed with a round steel, shaped like a plate, and having the center cut out, and a handle placed across the opening; the skin is then hung on an elastic pole, and the moon-shaped knife is drawn over the flesh until the desired result is secured. The skin is then ready to go to the cutters, of which there are two classes, the block and the table cutter, each class having as a rule separate rooms. The block cutters are engaged in cutting the cheaper and coarser grades of gloves. The skin is placed on a block made of hard wood planks placed on end and bolted together, and the die of the required shape and style is placed carefully on the skin, and given a blow with the maul. In the table cutters' room, tables instead of blocks are used. The skin is dampened, then stretched over the end of the table until it will stretch no more, and then cut off the length of the glove, next stretched to the width and cut off, after which the fingers and openings are put in with the die and press.

A table-cut glove, inasmuch as it is more elastic, and will conform to the shape of the hands, will give a much better fit than a glove cut on the block. In the cheaper and heavier grades, however, a perfect fit is not absolutely essential. The table cutters in the glove factories of the United States are of many nationalities, including French, English, German, Swedish, and in fact, they include representatives of every country in which gloves are manufactured. The foreign cutters are, so to speak, born in the glove industry, as for generations their families and relatives have obtained a livelihood by cutting gloves. To be a good table cutter requires an apprenticeship of at least three years, and even after this period not more than one out of three can be considered an excellent workman. The fingers of the cutter must possess the habit and nimbleness which can only be acquired by long practice. He must make a careful examination of each skin, and so shape it that he may get the greatest number of pairs of gloves, and yet avoid the flaws.

From the cutters' room the leather, which has assumed the shape of the glove, is sent to the "silkers," who embroider the back, and then to the "makers." Some make the gloves, that is they sew the fingers and put the thumbs in; others, called "welters," are engaged in welting or hemming the glove round the edge of the wrist; still others, called "pointers," work the ornamental lines on the back. After the glove has reached this stage of completion, the fourchettes and the thumb are put in place; the back is then embroidered and the end of the silk is pulled out and tied, and the glove closed by beginning either at the upper end of the long seam and sewing toward the little finger, or at the end of the under finger and finishing with the long seam. The glove is now ready to be bound, hemmed or banded, the button hole made or the lacings or fastener adjusted.

Each maker has his particular part of the work to do, and before a glove is finished it must pass through a number of hands. After the gloves are made, they are drawn over metal hands heated by steam, a "laying off" process as it is termed, and by means of which the glove is shaped and given its finished appearance. The gloves are now ready for inspection, and are assorted according to grades and sizes, and finally forwarded to the stock room, ready for shipment.

* Journal of the Society of Arts.

PROVISIONS IN COLD STORAGE.

A NEW PROCESS OF COLOR PHOTOGRAPHY.

K. WOREL describes in a recent number of the British Journal of Photography his process of color photography. The process depends upon the facts: (1) That certain red, yellow, and blue dyestuffs when spread upon paper, reproduce the color of the incident light, if the mixture be suitably proportioned to the sensitiveness of the different dyestuffs, and the exposure be sufficiently prolonged. (2) Certain essential oils enhance the sensitiveness of organic dyestuffs to the action of light. The evaporation of these oils by heat, and their solubility in certain liquids which do not dissolve the dyestuffs, afford the means by which the dyes may be reduced from the supersensitive to the normal state. Oil of anise was found to be the most powerful sensitizer, and the property was found to be due to the anethol. (3) Solutions of copper salts fix the dyes to an extent sufficient for practical purposes.

The process is carried out in the following manner: Writing paper, free from wood-pulp, is drawn through a bath composed of alcoholic solutions of Primrose, Victoria blue, a few drops of cyanine, curcumin, and auramin, and a certain amount of anethol. The composition of the bath is tested with a negative formed

of red, yellow, green, and blue strips of glass, by exposure to sunlight; if correctly adjusted, the four colors should be well rendered. The temperature of the bath should be 20 deg. C., and the paper should be dried at the same temperature. Prints are taken through a stained glass picture or a colored positive. The bath rapidly deteriorates. In general, great transparency of the original weak color baths, excess of anethol, and strong light give quick prints, while strong originals, strong color bath, a small amount of anethol, and weak light give slow prints. Weak color baths and excess of anethol also give weak prints, while strong color baths and less anethol give strong prints and greater permanence. After printing, the picture is transferred to a bath of pure benzine, left there protected from the light for an hour, and then dried at 30 deg. C. It is essential that the anethol be completely removed in this bath. The prints are fixed in a saturated solution of copper sulphate for two or three hours, and then washed and dried.—A. S.

COMMERCIAL CONDITIONS IN ASIATIC TURKEY.

THE following extracts are from the annual report of Consul T. H. Norton, of Harput, to appear in full in Commercial Relations, 1902:

This district is comprised of the two vilayets of Diarbekir and Mamouret-ul-Aziz, both largely pastoral and agricultural. Public security is not assured, and this, with the restrictions on the movements of the Armenian merchants, who constitute the bulk of the trading class, has caused widespread commercial stagnation.

Despite these untoward conditions, much has been done to establish and develop trade relations with the United States. Agencies are opened for different articles of American manufacture, and the prospect is favorable for the healthful development of direct trade in a variety of articles.

An interesting result of the establishment of this consulate at the beginning of 1901 has been the steady growth of direct exportations to the United States. Various products of the region have hitherto found their way ultimately to America, after purchase by merchants at Marseilles, or Constantinople, or in the seaports of Anatolia. I have endeavored to place the exporters of the region in direct communication, as far as possible, with American houses. A steady and rapidly growing trade in rugs, skins, and sausage casings has been established.

DIARBEKIR.

The merchants of Diarbekir purchase almost exclusively from wholesale houses at Constantinople, Aleppo, and Beirut. There are practically no dealings direct with manufacturers in any foreign country. The same condition of affairs exists with regard to exportations, nearly all transactions being done through commission agents. The Singer Sewing Machine Company, however, has its own agency in the city of Diarbekir, and within the past few months the direct exportation of goatskins, sausage casings, and rugs to the United States has begun.

There is a certain amount of trade with India through Bagdad houses. Unfortunately, during the past year, both the river route to Mosul and Bagdad and the main caravan route to Aleppo and Alexandretta have been rendered extremely unsafe by Kurdish brigands. Several valuable caravans have been plundered, and as a result trade has suffered severely. Formerly, caravans from the coast arrived almost daily; now they rarely exceed three or four a month, and are accompanied by strong escorts. The result is a marked decrease in both the imports and the exports of the vilayet.

Among the miscellaneous trade notes, the following are the most important:

Candles.—The annual import is valued at $3,700. France supplies 75 per cent of this amount; Belgium the remainder. It would appear that a large Belgian house will shortly monopolize this trade. Candles manufactured at Constantinople have been introduced, but the quality was so inferior that few sales could be made.

Cott n Yarn.—Diarbekir imports cotton yarn from England to the annual amount of 720,000 pounds, valued at $178,000. The favorite brands are those of "Mac Lore" and of "Hombart," from Manchester. A spinning mill at Adana sells here annually 300 bales of yarn, valued at $16,100. Numbers 14 and 24 are chiefly in demand. They sell at $1.92 per packet of 10 pounds. Purchasers dye the yarns with aniline dyes to suit their requirements.

Handkerchiefs.—These are largely used for head coverings. They are rolled together to form turbans. A Kurd will frequently incorporate a score of handkerchiefs into his turban, so that the total weight, including the fez, exceeds 2 pounds. These handkerchiefs, of light cotton cloth, were formerly imported from Switzerland; now, they are brought from Tokat, near Sivas. Diarbekir importers dye them in rather loud colors, to suit the local taste. Pocket handkerchiefs, both white and in colors, are imported from England. The annual value is $6,700.

United States Trade.—The part of the United States in the commerce of Diarbekir is chiefly confined to receiving a large share of the wool, sausage casings (sheep's intestines), and leather. The importations from the United States consist of sewing machines, nails, and a small amount of books, furniture, and clothing for the American mission station at Mardin. There is a small group of naturalized American citizens in and near the city of Diarbekir. The temporary residence in the city of Diarbekir, during the past two years, of a distinguished American surgeon—Dr. F. D. Shepard—has done much to further American influence in this region. A German surgeon is now located permanently at Diarbekir.

MAMOURET-UL-AZIZ.

Cotton.—This region produces an excellent grade of cotton, and should be the seat of an extensive cotton spinning and weaving industry on account of the abundance of water power. The native manufacture, dependent entirely upon hand power and using chiefly yarn of English make, is steadily waning, finding it difficult to compete with the products of English, German, and French looms.

The Harput orphanage, conducted and sustained by American benevolence, has introduced the weaving of attractive patterns which meet the popular taste, and is doing much to enable local industry to meet foreign competition. American "Cabot A" has promptly gained a good foothold here, and is highly appreciated. It has been forced, during the past year, to contest the field with an Italian sheeting of inferior grade, imitating very closely the American trade-mark.

American "Cabot S" has appeared in the Harput market during the present season for the first time, and meets with even more favor than the "A" mark.

There is an excellent opening here for American yarns, calicoes, prints, sheetings, and, in fact, all varieties of cotton textiles. White yarn only is imported. It is found cheaper to dye the yarns here.

Rugs.—There is a steady but limited production from the Kurdish looms of the region, extending but little beyond local needs. Circassians have lately established in this city the weaving of rugs of genuine Persian designs, and much is expected from their undertaking. The rug department of the American orphanage, referred to above, is steadily perfecting its work and turning out products which find a ready sale in the United States. Much of the work is done to order after designs sent from America. It sells at $1 per square foot, a price much in excess of the average oriental make.

The widespread use of the brilliant but fugitive aniline dyes in coloring the materials used for rug weaving in Turkey leads to a steady depreciation of their value in the eyes of European and American connoisseurs, when contrasted with the products of Persian looms. It is worthy of note that the yarns employed in the American orphanage are dyed exclusively with vegetable coloring matters.

TRADE WITH THE UNITED STATES.

I am glad to chronicle a steady increase in importations from America into Harput since the establishment of this consulate at the close of 1900, as well as a marked increase in direct exportations to America.

The following are the more important branches in which a foothold has been gained which promise development.

Bicycles.—Following the introduction of the bicycle which I brought with me, there has been an importation of twelve American wheels. The roads about Harput are well adapted to wheeling, and during the coming year it is planned to introduce our bicycles at Diarbekir, Malatia, and Karahissar, all places surrounded by excellent highways. An agency for American bicycles is organized here and sells a strong, durable wheel of simple type, well adapted to the needs of this region, for $30.

Irrigation Appliances.—An agent has taken up the introduction of irrigation machinery. A consignment of American pumps and horse power has been received the past summer, and has already been put into active operation. This simple and economical method of raising water is well adapted to the needs of the great Harput plain, where water is found abundantly not far from the surface and animal, as well as human, power is exceedingly cheap.

The question of irrigation here, as in the southwest of the United States, outranks every other factor in the economic development of the country. Negotiations have already commenced for the introduction of our windmills for raising water. I have devoted much attention to the matter with local capitalists. They are endeavoring to raise a fund sufficient for the purchase of an American drill. Should the experiments with either method yield satisfactory results, there would be no hesitancy in adopting either or both forms of solving the problem.

Agricultural Implements.—As mentioned in my last annual report, an agency for the sale of our agricultural machinery and implements was established in 1901, and a variety of plows, harrows, and drills, as well as a reaper, were imported. The experimental trials have been made upon an extensive farm near the Euphrates, some 25 miles from this consulate. Some time was lost in training horses to work with the plows and other implements.

The results obtained from the deep plowing of the American plows was striking, when compared with the yield of grain in adjacent fields where the ground had been "tickled" by the primitive native implement. Equally striking results were obtained when the wheat drills were employed instead of the customary broadcast seeding. The reaper was used during the harvest of the past summer. After overcoming some minor difficulties, it was found to work quite successfully. It now accomplishes in one day the work of 40 men. When both horses and drivers are thoroughly accustomed to the work, it will probably replace 70 to 80 men.

As the chief item in raising grain here is the cost of harvesting, it may readily be imagined that the introduction of such a labor-saving appliance caused no little stir in a region where the laboring population is so exceptionally dependent upon the earnings of harvest time. Soon after the reaper was running regularly and smoothly, the price of a day's labor descended promptly 30 per cent—from 20½ cents per diem to 14 cents. The enterprising agent—a graduate of an American agricultural college—was forced at once to face a condition of affairs similar to that which followed the introduction of the spinning jenny and the cotton gin. Every attempt was made to wreck the dreaded innovation, so that it was necessary to keep it at night in the owner's habitation. His garden of American vegetables was destroyed, his fruit trees were cut down, shots were fired at his house during the night time, and his workmen were induced to desert him. In spite of all these discouragements the experiment was pluckily continued to the close of the season. Another year will see the more widespread use of the reaper and the introduction of the threshing machine. Both machines will be transported from farm to farm as needed by individual or corporate owners. There is probably no single farmer in the vilayet whose cultivated lands are sufficiently extensive to warrant the purchase of even a reaper for his individual use. The chief difficulties in the way of using the reaper extensively are the terraced arrangement of irrigated fields, the smallness of individual holdings, the abundance of stones, and the existing habit of cutting the grain close to the ground, in order to secure the maximum of straw. The thresher, when introduced, must be accompanied by a straw-cutter. The straw is withdrawn from the old-fashioned "threshing-floors" in a very soft, finely cut condition. The population is so accustomed to straw in this condition that it is useless to attempt to introduce machinery leaving it in any other form. An illustration of the tenacity with which they hold to the old methods is the practically universal demand of the farmers, in ordering American plows, for the reversible or "sidehill" plow. In plowing with the primitive oriental implement, it has always been customary to plow back and forth, and not around the field. The farmers here, while recognizing promptly the enormous superiority of a share and moldboard, still dislike to deviate from the ancient method of conducting the operation. In many cases, however, when using plows on long, narrow terraces in irrigated fields, they are probably correct in preferring a reversible type.

Hoes, rakes, pitchforks, and other small farm and garden implements are favorably received, and there are good prospects of a steady trade springing up. Probably, the metal parts only will be imported and handles will be attached here. This is the practice with regard to the large number of shovels imported from Europe. There is, however, an unfortunate lack in this region of ash, hickory, and similar woods adapted for this purpose.

Fanning mills are used universally. They are modeled after a mill introduced by an American missionary some years since. The metal parts are imported from the United States, with the exception of the wire gauze for the screens, which is brought from France. Native carpenters here turn out annually from 150 to 200 of these fanning mills, which are sold at prices ranging from $5 to $9 and render good service.

Hardware.—American nails are steadily occupying the market, displacing the Belgian article. At present, about equal amounts of both are imported. The American nail is, however, regarded as much stronger and better adapted in every way. It will apparently soon have exclusive possession of the field.

Roofing.—American steel roofing has been used in the rebuilding of the various edifices of Euphrates College and of the American mission station at Harput, destroyed in the unfortunate events of 1895. Its manifest superiority to the fragile tile roofs and ponderous mud roofs hitherto in vogue has quickly been recognized. The new city hall of Harput is covered with this roofing, and a large school building in process of erection is to have the same covering.

Shoe Pegs.—There is a large consumption of wooden shoe pegs in this country. It is met partly by importations from Germany and partly by a crude native product, laboriously made by hand. I have secured samples and prices of American pegs. The quality and cost are so satisfactory that a consignment has been ordered and is now on its way hither. There is every prospect that a trade of some importance can be built up.

Sewing Machines.—The agency of the Singer Machine Company, started here two years ago, is doing a very satisfactory business. It has branches at Diarbekir, Mosul, and Bagdad, and has just started a new one at Bassorah.

The sales in the four vilayets during the past year were:

	Number.
Mamouret-ul-Aziz	140
Diarbekir	65
Mosul	115
Bagdad	80
Total	400

The receipts from all the agencies amount to $11,000. Over 500 machines are now on deposit in the different agencies. The demand at the outset was largely for light machines turned by hand. Now the somewhat more costly machines, with treadle, are sold more freely. The great majority of the machines are sold on the installment plan. There seems to be no difficulty in making collections.

The success with which these machines have been introduced in this region and in Mesopotamia, completely displacing all foreign competition and covering promptly and effectively so extensive a territory within two years, is a most striking lesson to all American manufacturers desirous of establishing themselves in a country possessing great potential commercial possibilities.

Books, Furniture, and Clothing.—Euphrates College and the mission station at Harput import annually from America books to the value of $550, and furniture, clothing, etc., to the value of $2,900.

Life Insurance.—The agency of the New York Life Insurance Company, established here over a year ago, is extending its operations to adjoining places. During the past year, 66 lives have been insured in the near-by towns of Arabkir, Eghin, and Arghani Maden. In this city few policies were taken out during the past year, although quite a number were insured immediately after the opening of the agency. There seemed to be a general disposition to wait and see what would happen when a policy became due. The first death of an insured person occurred a few months since. The amount of the policy—$1,100—was paid at once, and this promptitude has inspired general confidence in American insurance methods.

Tools and Machinery.—Some American tools, for working both wood and metal, have found their way here and are thoroughly appreciated. Artisans and mechanics are unanimous in desiring that a regular importation of the articles could be brought about. Inquiries are frequent for small steam and petroleum engines, for lathes, for sawmills, for flouring mills, for cotton and wool machinery, for water-power outfits, and for cotton gins. Some forty gins are now working in the Harput plain. They are all of English origin, and fifteen are of quite modern type. Each

one requires 4 horse power and cleans from 350 to 850 pounds of cotton daily. These gins, delivered at Mezreh, with their accessories, cost $154. On an average, such a gin earns annually about $50 net profit, after deducting the cost of labor, water, repairs, etc.

Clocks and Watches.—There is a steady demand for both articles, especially for those provided with Turkish figures on their faces. Timepieces from America come frequently as gifts and are highly valued, but no direct importation has been attempted.

Textiles.—There is an excellent opening for nearly every variety of textile. Plain sheetings from America have proved so satisfactory that the market is ready to receive a large variety of cottonades, handkerchiefs, towels, etc.

Shoes.—Probably no article of American manufacture, if properly introduced, would succeed better here than the American shoe. It is well known, for a large number of emigrants from this district are engaged in the manufacture of shoes at Lynn and other towns of eastern Massachusetts.

Packing of Goods for the Harput Market.—So much depends upon the care with which goods intended for markets in the interior of Asia Minor are prepared and packed for the long journey, that the following information may be helpful to manufacturers or merchants seeking to gain a foothold here. In order to secure the lowest possible freight rates, packages should be adapted as far as possible to local requirements.

Wagon transportation is available for freight forwarded to the seaport of Samsoun. It is the only means of transport and the route the only means of communication available for packages exceeding 240 pounds (85 okes) in weight. Wagoners are unwilling to take packages exceeding 510 pounds (180 okes). Such packages, as well as light packages of large or awkward volume, pay excess freight. The maximum weight of a package which can be transported by wagon is 1,415 pounds (500 okes).

In packing for this market boxes or bales which are to be forwarded by wheeled transportation, care should be taken to have the cases and wrappings of a thoroughly solid and substantial nature and to pack the contents so tightly that there is not the slightest possibility of friction. These precautions are of prime importance, in view of the journey of fifteen to twenty days in springless, jarring vehicles over highways originally well constructed, but now in a sadly dilapidated condition. Samsoun agents protect packages, when necessary, with coarse waterproof coverings before forwarding to the interior.

As an instructive example of freight charges on goods from abroad, I might quote the following data on a recent consignment of American agricultural implements to Harput: The lot included 1 mower, 3 plows, 3 cultivators, 1 harrow, 40 rakes, hoes, and forks, 2 sets of harness, etc.; gross weight, 2,839 pounds; net weight 1,999 pounds; cubic feet, 136.8. The freight rate from New York to Samsoun was $14.07, plus $1.80 insurance and $2 cartage in New York. The freight charge from Samsoun to Harput was $55, the rate being slightly higher than usual on account of the presence of two very bulky cases.

When pack horses or mules are employed, the necessity for very compact and tight packing is less imperative than by the preceding method. The range of weight is, however, much more restricted. The normal weight for a package to be carried by the average horse or mule is 177 pounds (62½ okes). Muleteers dislike to take heavier loads, but occasionally accept packages weighing up to 198 pounds (70 okes). For packages of less than the normal weight, one-half or one-third of the above figure—177 pounds—can be adjusted most advantageously to the pack animal. The preferable shape of a package is oblong, the proportions approximating those of a customary dress-suit case.

The above remarks concerning shape, division of weight, manner of packing, etc., apply also to transportation by camels. This method is the least expeditious, but on the other hand the cheapest and the most satisfactory of all the means of freighting. The slow, deliberate tread of the camel causes a minimum of jarring to the contents of the boxes. The preferable weight of packages for camels is 226 pounds (80 okes); the maximum weight is 246 pounds (85 okes).

Freight rates from Samsoun to Harput, a distance of 307 miles (495 kilometers), vary from $1.40 to $1.97 per 100 pounds ($31.36 to $43 per ton of 2,240 pounds, or $3.09 to $4.34 per metric quintal of 220 pounds), or 10.2 to 14 cents a mile per ton of 2,240 pounds. Camel transport is the cheapest form of transportation; freight wagon the dearest. The latter method is most expensive in winter and early spring, when mud is deep and the mountain passes are obstructed by snow. Transport by pack animals is cheapest in the spring and early summer, when herbage is abundant by the wayside and the cost of subsistence en route sinks to the vanishing point.

Summary.—In conclusion, I would repeat my conviction, as expressed a year since at the close of the first annual report from this consulate,* that there is an exceptionally good opportunity in this district for American commercial enterprise to gain a substantial and permanent foothold.

Geographical and physical conditions show clearly that this region, about the headwaters of the Euphrates, is destined at an early date to play a leading rôle in the economic development of eastern Turkey and of Mesopotamia. Its mountains contain varied mineral treasures awaiting exploitation. Its plains and valleys are exceptionally fertile. The climate is one of the healthiest known. Its water power is sufficient to make it a manufacturing center of continental importance. The political power which controls its water supply controls the very existence of the population of Mesopotamia, which has been, and should be again, the garden of the world.

Thus far no European house or agency has been established in the district. It is practically "virgin territory."

The favoring conditions for American enterprise are:

First. The large emigration from this district, settled almost exclusively in the United States, has given rise to a familiarity with American articles and taste for them, and has brought about personal relations between the two countries which are of incalculable value as a foundation for business connections.

Second. There is, in addition, a notable confidence in American integrity and in the quality of American wares, heightened by the growing dissatisfaction with the cheap articles imported from Europe.

Third. Thanks to the long-continued labors of American missionaries and teachers at Harput, English is the prevalent foreign language of the region.

The chief difficulties to be overcome in establishing trade relations with America are the following:

First. The lack of confidence in the existing administrative conditions, in Turkish judicial procedure, and in the political future of this region.

Second. The diminished stock of ready money in circulation.

Third. The unsettled state of credits, resultant from the rude shock to the commerce of the country during and subsequent to the massacre of 1895.

Fourth. The length of time necessary for correspondence with the United States. An exchange of letters between Harput and New York requires two months.

Fifth. The high freight rate from the littoral and the delay in receiving American consignments, due to absence of direct sea communication with transatlantic seaports.

* Commercial Relations, 1901, Vol. 1.

ADVANCES MADE IN PHARMACEUTICAL MACHINERY AND METHODS IN THE LAST HALF CENTURY.*

By WILLIAM JAY SCHIEFFELIN.

IN their scale of operations, in the use of machinery, and in the variety of their products, pharmaceutical manufactures have developed more during the past fifty years than through all the preceding centuries.

In 1852, when the medical world was emerging from the jalap and calomel age, the pharmacist made his own galenicals, pills and elixirs, and bought the crude drugs. Most of the manufactured products purchased by him came under the class of heavy chemicals and were of mineral origin. Besides the common acids alkalies, alum and sulphur, the list included the mercurials, lunar caustic, arsenic and powder of algaroth, sugar of lead, sulphate of zinc, magnesia, bromide and iodide of potash and Labarraque's solution.

Alkaloids and organic compounds were few and were used in very limited quantity. Morphine and quinine, chloroform, alcohol, ether and collodion, besides acetic, tartaric and oxalic acids, were the chief ones.

The civil war, with its demands for medical supplies, stimulated the manufacturers; the need of large quantities of pure extracts led Dr. Squibb to establish his laboratory, and the abilities of that great man were devoted to perfecting the processes of pharmaceutical manufactures.

His process of preparing fluid extracts by cold repercolation may be put at the head, and his suggestions on the valuation of drugs and the assay of opium, on the manufacture of ether, acetone and cocaine, and of acetic extracts, should not be forgotten.

Among those who have passed away and who should be remembered with honor and gratitude for their services to scientific pharmacy in America, are Proctor, Maisch and Rice. These men made the United States Pharmacopœia the most perfect book of its kind in the world.

The Pharmacopœia, with its formulæ constructed on a scale intended for the convenience of the retailer, became nevertheless a guide to the manufacturer, and the retailer found it advantageous to buy his standard pharmaceuticals ready made. The reasons for this are truer to-day than they were then; they are as follows:

(1) The retail pharmacist can not devote the time to manufacturing.

(2) Making fluid extracts in small quantities is uneconomical because of the loss of the alcohol which is recovered in a large way; the cost of labor, which would be about the same for one liter as for 200 liters; and the forming of a deposit in many extracts which would never have time to clarify if used at once for dispensing; then the standardization of alkaloidal extracts would greatly increase the cost of one liter, but not of 200.

(3) It is very evident that 1,000,000 pills or tablets can be more cheaply made than 100, and it is extremely convenient to have pills and tablets of a given formula all of one size with the materials evenly distributed. The retailer demands and receives liquid preparations which remain clear and emulsions that do not separate; it may be doubted if this would always be the case if he made them himself. Therefore the large manufacturing plants of to-day have developed. Fifty years ago the manufacturers supplied small quantities of morphine, chloroform, ether, galenical extracts, elixirs, opodeldoc, mercurial and other salts. Ten years later the list of fluid extracts had greatly increased; while in 1870 extracts with glycerine were in favor. Then the coated pills were introduced and the business increased to very large proportions until the cheaper tablets and triturates partially replaced them.

In 1857 a paper was read before the American Pharmaceutical Association mentioning gelatine capsules, sugar-coated pills, cod liver oil emulsion, and the effervescing salts which Mr. Maisch had described the year before; it is remarkable that so many years passed before all these came into general use. The soft gelatine capsule is one of the greatest improvements in administering drugs that has been made.

In 1885 the synthetic remedies were introduced from Germany. Antipyrine was soon followed by acetanilid, phenacetine, sulfonal and many others. Our schools of science awoke to the value of research work when the patient Germans produced these preparations.

The English and French chemists had supplied scarcely any synthetic remedies, and so the backwardness of the Americans would not have excited much comment, were it not that certain persons put on the market mixtures containing chiefly acetanilid, proclaiming them as new chemical compounds, great American discoveries, and which were the cause of much disparagement and ridicule of American methods of synthesis.

Nearly all of these imitation synthetics have disappeared, and it is a reproach to us that any have survived—for there can be no denying that to launch a product by a misrepresentation is disreputable.

In every succeeding year new remedies, genuine synthetics, have appeared. Among those which have survived and are in considerable demand to-day may be mentioned acetanilid, antipyrine, aristol, chloralamid, creosotal, formaldehyde, heroin, phenacetine, phenocol, salophen, salol, sulfonal, thiocol, and urotropin.

Besides the older organic compounds: chloral, chloroform, carbolic acid, ether, ethyl nitrite, iodoform, naphthaline, and salicylic acid.

Ethyl nitrite is made in several American laboratories and its consumption here approaches 40,000 pounds a year. The makers of essential oils also manufacture synthetic perfumes and flavorings, such as vanillin, coumarin, saccharine, ionone and heliotropine, oil of sassafras, and oil of wintergreen.

In these processes the organic solvents are largely used—alcohol, ether, naphtha, chloroform, acetone, etc. The German maker, with cheap alcohol, has an immense advantage over the American, and if the tax were removed from alcohol used in the arts, our progress would be unimpeded.

Electrochemistry has but slightly affected pharmaceutical manufacturing. Iodoform, vanillin, carbon disulphide and hypochlorites are beginning to be manufactured with the aid of the electric current.

The making of infants' and invalids' foods is a branch by itself and digestive ferments are prepared in liquids and solids in efficient and attractive form.

While in pharmaceutical machinery the Americans are far in the lead, the German apparatus for work in organic chemistry is pre-eminent. Think of autoclave, lined with acid-resisting material, having a capacity of 500 liters, with stirring paddles working under a pressure of sixty atmospheres.

Ingenious machines are now very generally used in American pharmaceutical laboratories. The modern pill machines are marvelous, especially the final one, holding the pills by suction as they are dipped in the coating, which enables one girl to coat 100,000 pills in a day, etc.; and tablet machines are now in use which stamp twelve tablets at a stroke and make 500,000 in a day. One young girl attends two machines and thus makes 1,000,000 tablets in a day.

Perhaps the two greatest aids to manufacturing pharmacy are vacuum distillation and centrifugal extraction. The former has long been in use, but the latter has only come into general use in this country during the past fifteen years.

The immense filtering racks and presses that formerly encumbered a laboratory are now usually replaced by centrifugal machines which take up but little room and save much time, while the quantity of wash liquor is so reduced that the loss by washing is unimportant. The cheapness of certain leading products is due almost entirely to these machines—aloin is an example, as it must be well but quickly washed or it is decomposed.

Fifty years ago the medical world was much interested in glycerine as a remedy for the skin, as a solvent for drugs and as a vehicle for administering them. The use of it has grown to vast proportions, and the service done by Chevreul should always be acknowledged.

Glycerine, ox gall, and vaccine were almost the sole animal products then on the druggist's list, but pepsin soon followed and pancreatine, while during the past ten years the laboratories have annexed the barnyards, and the serums and toxins and extracts from glands have become of great importance. These biological departments are under the direction of scientists trained in bacteriology, which demands niceties of cleanliness and carefulness of sterilization that would be a revelation to the apothecary of fifty years ago.

The makers of plasters and surgical dressings also have splendid vacuum appliances of great size for sterilization.

Extract of malt is made tons at a time in low pressure vacuum pans, while diastase is prepared in a wonderfully active state.

By-products of the huge packing houses are extract of beef, pepsin and pancreatin, and stearin; while the creameries make sugar of milk and caseine.

Returning to our laboratories, the most important galenicals they make besides the extracts are aloin, santonin, resin scammony, and resin podophyllum. Then there are a variety of emulsions, elixirs, syrups, and medicinal wines.

The large pharmaceutical laboratories have been l- dably enterprising in their research for drugs and have introduced some of great value—cascara, for instance.

The demand for the chief alkaloids has steadily increased until the production of quinine and morphine has become enormous. The estimated annual consumption of quinine in the United States is five million ounces, and that of morphine is four hundred thousand ounces.

The manufacture of strychnine, caffeine, and cocaine has developed so greatly that it seems at the present time to be ahead of the consumption, large though it be.

Fifteen years ago cocaine sold by the grain and now its annual consumption in this country approximates one hundred thousand ounces.

Most of the mineral acids and salts sold by the druggists are heavy chemicals and are now made by the combination. Rochelle salt, cream of tartar, magnesia, borax, and chlorate of potash have long since outgrown the pharmaceutical laboratories; but these still make the salts of bismuth and certain salts of iron and manganese and of mercury besides iodides and bromides and phosphates and peroxides of hydrogen, while latterly several have undertaken the manufacture of lithia from its minerals, lepidolite from California and spodumene from Dakota, with the result that the price

* Read at the Special Jubilee Session of the American Pharmaceutical Association, September 11, 1902.

has fallen in two years from $3.30 to $1.30 a pound, because the capacity of the plants is perhaps double the consumption, which is about sixty thousand pounds a year.

So the pharmaceutical chemist, like the alchemist of old, finds his material in rare and beautiful minerals, in the cells of outlandish plants and in the blood of live animals, but his processes are lighted by the lamp of science, and instead of working with a few ounces he operates with quantities of thousands of pounds. The future of pharmaceutical manufactures is bright, for the standards are right, which is largely due to the men of this association and their like.—The Pacific Drug Review, Portland, Oregon.

THE NAVAL WAR GAME.—V.*

By FRED T. JANE.

HOW HITS ARE DETERMINED.

IN response to numerous queries from our readers, we give here a fully detailed account with illustrations of the methods by which shooting is simulated in the naval war game.

The first diagram is a "target" reproduced the actual size. It is one of the French "Charlemagne" type, this vessel being specially selected as one of the best to illustrate the system. For the sake of argument we will assume her to have been fired at by the U. S. S. "Maine" with a broadside of four 12-inch and eight 6-inch R. F. guns.

Firing is done on pictorial targets like the one we illustrate. It is done with an instrument called a "striker," which is in essence a fine needle inserted nearly (but not quite) in the center of a thin, flat board approximately of the same size as the target shown. In every striker the position of the needle point varies slightly. Each striker is fitted with a handle 12½ inches long—12½ inches being the scale for 1,000 yards in the game.

The player holds the striker at the end of the handle much as a hammer might be held. He notes the needle point, then, fixing his eye on the spot desired to be hit, endeavors to strike it. This in some 75 per cent of cases can be done by anyone *provided* he is absolutely cool. The slightest tension or excitement, such as an extreme desire to hit may cause, probably produces a miss. Thus not only the chance element—so essential to any realistic simulation of naval war—is provided, but also "moral effect." Experience indicates as an invariable fact that directly a player's ship is badly knocked about, directly it is of the most urgent importance to him to secure hits to avoid defeat, so in strict ratio does his accuracy decline. It is a curious fact, too, that the worst shooting is often made on the big "2,000 yards" target. Ordinary excitement is thus made an asset of value in simulating actual war.

Countless alternative methods of imitating gun fire have been suggested and tried—indeed, the tyro almost invariably suggests "improvements" in this direction. As invariably, however—once he has warmed to the game—does he refuse to accept any of these alternatives. Once the principle is understood, it is realized that nothing else gives the mixed skill and chance factor so well as the apparently rudimentary device; nor can any system of dice or points differentiate so easily between actual ships. By this actual ship system, a choice of projectile that will destroy the "Maine" may leave the "Charlemagne" little hurt, and similarly shell fire enough to destroy the "Charlemagne" may affect the "Maine" very little.

Holding the striker at least a foot away from the target lying on the table before him, the player strikes for such big guns as he may have available. He strikes at the target suitable for the range and position, gaged from the positions of the models during the one minute move preceding. These big guns he may strike for fairly leisurely—he is allowed, for instance, to see where the first hit went before firing the second—as a rule. His gun is assumed loaded with common shell; if he desires to use any other projectile, he must have notified the umpire that he has loaded with it the move before. His big guns fire on alternate moves only, and in the case of some guns at far longer intervals.

Against each hit made by the needle point he marks the projectile and its nature.

He then fires his R. F. guns, which—unless anything else is claimed beforehand—are assumed to discharge high explosive shell.

These R. F. guns he strikes for in rapid succession, one strike for each 6 or 8-inch gun. A couple of 5 inch or 4.7-inch counts as one 6-inch, and one strike is allowed for the pair. Lesser guns are usually not struck for; if they are they are commuted on the scale that four 3-inch equal one 6-inch, assuming both to fire for one minute.

The target is then (without further inspection by the player as a rule) sent to the umpire. In the case illustrated he demanded the "scorer" for the "Charlemagne" (Fig. 2). On this scorer, which is a plan of the ship divided into vertical sections of 25 feet each, the umpire scores the damage by scale.

One minute's 6-inch fire doing 1 section per gun.

One minute's 8-inch R. F. fire doing 1½ section per gun.

One minute's 9.2-inch R. F. fire doing 2 sections per gun.

One minute's 12-inch R. F. fire doing 4 sections per gun.

A 13-inch doing 6 and a 16-inch 10 sections horizontally, supposing the spot hit to be unarmored. This is common shell fire. With A. P. shell about half the effect would have been secured, with A. P. shot a quarter.

Where armor is hit the question of penetration enters. Armor is notated as follows:

aaaa = 36 inches iron, or its equivalent.
aaa = 30 " " "
aa = 24 " " "
a = 18 " " "
b = 15 " " "
c = 12 " " "
d = 9 " " "
e = 6 " " "
f = 3 or 4 " " "

Penetrations are scaled from this according to the actual penetrations of the guns engaged, with the proper reduction for impact at an angle. When a ship is at an angle (and this the models indicate) hits only count on the half or other fraction of the target that would be exposed. For many hits rules are impossible. In such cases common sense is used by the umpire, who always has to bear probabilities of actual war in mind.

In the illustrations given it will be noted that one 12-inch (A. P. shot) hit an unarmored spot. Obviously it would pass through and do no harm. The second—a 12-inch high explosive shell—hit the after turret fair and square. The verdict was that both guns would be disabled. They were therefore crossed out in the "scorer," and the player of that ship might use them no more. The other two big guns missed.

Let us now take the 6-inch. The first hit section 1 maindeck. It destroyed a section there. The next hit the water line, section 2. It could not penetrate, so did no harm. The third chipped the fighting top. The fourth burst underneath the guns in section 5. Such a burst might do little harm or a great deal—it is pure chance which. The umpire threw a die to decide. The result was provided for:

6. Both guns out for good.
5. Both guns out for five moves.
4. Both guns out for two moves.
3. One gun out for five moves.
2. One gun out for two moves.
1. No harm to guns.

A "six" was secured, so both guns (port and starboard) were crossed out and not allowed to fire again.

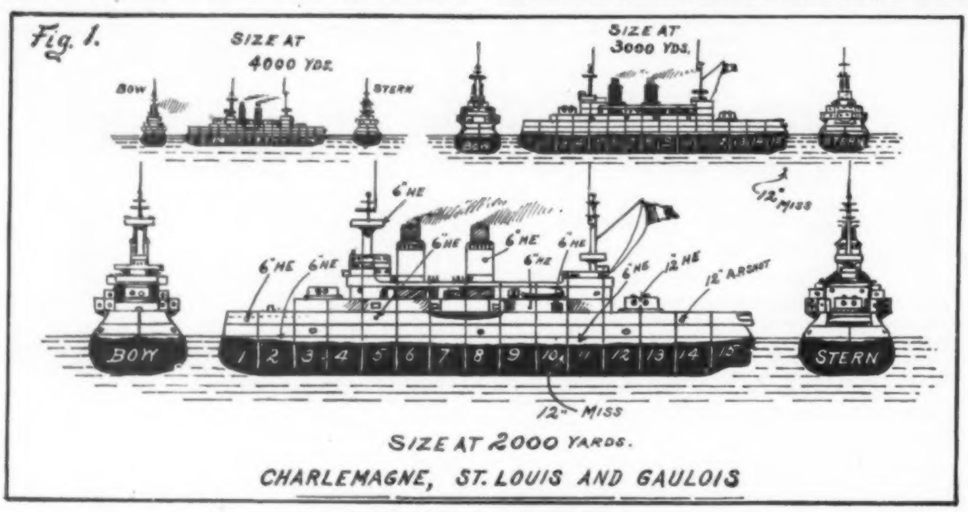
The fifth shell hit the battery armor, and, failing to penetrate, did no harm (section 9).

The sixth entered the gunport in section 10. Here it would certainly wreck the gun. It might wreck the gun on the other side, but the battery screen prevented it in this case.

The seventh shell, hitting thick armor in section 11, waterline, did no harm. Shell eight was a fair and square funnel hit, again one that might or might not blow out the fires. A scale of dice decided the result. A "six" entailed loss of speed by blowing out of all fires served by this uptake, lesser numbers a lesser loss. A "five" was secured, and two squares speed (equal to six knots) lost.

For the rest it will be noted that record is kept on the scorer of the R. F. guns bearing in any direction and a tally kept accordingly.

Apart from the interest that this simulation of shooting produces, it may be observed that the system teaches the guns and armor of warships in a singularly easy way. The great value of the game lies in this direction; and it is a remarkable thing that the British Admiralty, which some two years ago adopted the game for use at Greenwich Naval College, took the alternative system of points in preference to the proper shooting method, using the game only for tactical lessons, which pieces of wood could have simulated equally well. In several other instances in other countries the official mind has proceeded along the same lines. Where, however, the game has been adopted for military purposes, for coast artillery training, the orthodox shooting system that we have described is used, and the result has been that the military when



SPECIMEN OF A TARGET.

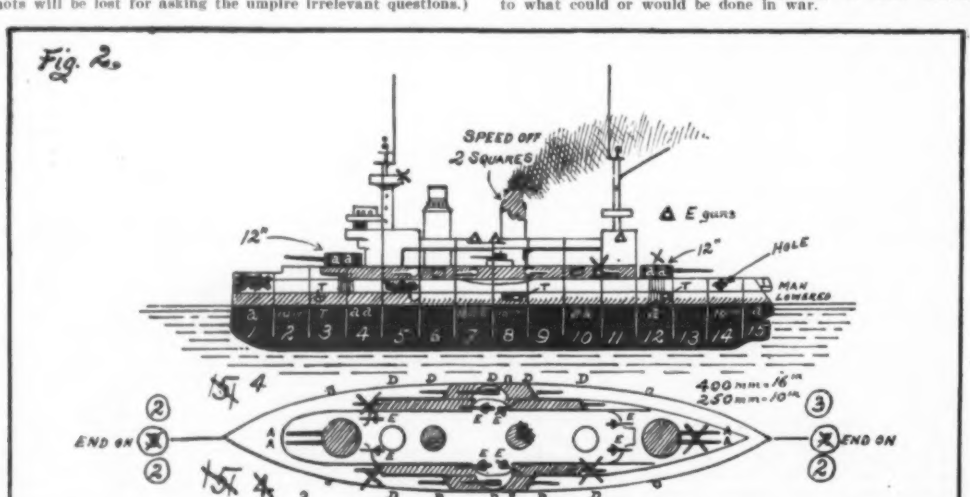
The three groups of figures (bow, broadside and stern) represent the relative size of the ships, as seen through the telescopic sights, at 4,000, 3,000 and 2,000 yards. It will be readily seen that the chances of hitting the particular point (turret, gun, conning tower, etc.) aimed at are increased at the closer ranges. The player strikes with the needle-point striker (as explained in the article) at a paper target similar to this, selecting the diagram corresponding to the range of the ship that he is attacking.

1. From *open fire* no admiral may speak about the game. If he does he will be counted "dead," and command pass to the next in seniority at once. The same applies if the admiral shoots for, or in any way assists the shooting of, another ship. Each captain is to take his own target (all are marked). Any captain communicating information to the admiral (save by signal) will lose from 3 kts. speed to a complete breakdown at umpire's discretion. Signals can be made with buoys (4 sorts allow 32 varieties). Others must go through umpire, written on paper. Any player hoisting a signal on a shot-away mast will be treated as "communicating information," and punished as above.

2. As games are often unduly prolonged by players questioning the umpire's decision, notice is hereby given that, as umpiring is on a uniform system carefully worked out, *this will not be allowed. Any player doing so will have his steering gear permanently disabled.* It is of the utmost importance that the play should be as rapid as possible. (3 knots will be lost for asking the umpire irrelevant questions.)

3. Q. F. guns will be fired first, then big. Players who cannot fire in the alloted time will not be allowed to shoot. The Red side are always to send up targets first. Only one target per ship is allowed. Nothing will be scored when the target is torn. The umpire gives the range, deducting for speed, etc.

4. Each player is to keep his scorer in his pocket ready to hand to the umpire when called for. If he shows it to anyone it will be treated as "communicating information." Everyone who fires at a ship and *makes a hit worth scoring* (i.e., affecting speed, guns, torpedoes, or steering) is to call out the name of the ship hit. The player of that ship is at once to have his scorer ready for the umpire to mark. The umpire will notify damages that could be seen—a bad funnel hit with brown paper—a bad hit in battery by white paper—placed over the ship. A ship whose buoys are taken away may not steer. All temporary damages last till umpire removes indications. Nothing may be done contrary to what could or would be done in war.



THE "SCORER," ON WHICH THE HITS MADE ON THE "TARGET" (FIG. 1) ARE NOTED DOWN AS THE FIGHT PROCEEDS.

EXPLANATION OF NUMBERS AND LETTERS ON DIAGRAM.

Guns.
4 A = 12-inch.
10 D = 5.5-inch rapid fire.
8 E = 4-inch rapid fire.

Torpedo tubes.
4 submerged in sections 3 and 12.
6 above water in sections 3, 8 and 12.

Armor.
Belt *a a a* to *a* = 30 to 8 inches of iron (equivalent of).
Protection to engines, *a a a a* = 36 inches of iron.
Lower deck belt, *c* = 6 inches of iron.
Battery *d* = 9 inches of iron.
Turrets *a a a* = 30 inches of iron.
Hoists *a a a* = 30 inches of iron.

* Prepared especially for the SCIENTIFIC AMERICAN by the well-known naval expert and inventor of the naval war game; with exclusive rights ... United States and Great Britain. This series was begun in the SCIENTIFIC AMERICAN SUPPLEMENT of December 20, 1902.

playing against naval officers usually defeat them in any conflict demanding knowledge of the weak points of warships. This it is that has in England given rise to the latest theory that tactics unless very brilliant indeed will, in these days, be second to scientific selection of projectiles suitable for the ship to be attacked. And, as any of our readers may test for themselves in the illustrations given, "discriminating fire" is no more possible at war game than in actual fact. The ship as a whole is the target. The "Charlemagne" we give is an instance of bad selection. To fire armor-piercing projectiles at such a ship is an error, for the area to be so damaged is small. The area to be destroyed by shell is, however, great.

In the next issue of the SUPPLEMENT we shall publish the result of the meeting of the American and German battleships in the Philippines. It will be remembered that at the opening of the war a powerful German fleet, containing seven battleships, accompanied by several cruisers, torpedo-boat destroyers and transports, set sail for the Philippines pursued by the American European Squadron. The American fleet in the Philippines was greatly inferior in strength to the German fleet, and the story of the uphill fight made by our ships is extremely interesting reading.

THE AUTO-CHRONOGRAPH: A NEW ELECTRIC TIMING APPARATUS FOR AUTOMOBILES.

As measuring the speed of automobiles is an all-important matter, the details of the apparatus at present used, as well as some of the modifications that would seem desirable, will doubtless be found of interest. The method of chronometry now employed consists in the use of one or more chronometers alone, or in conjunction with electric apparatus, which diminishes a portion of the labor of the time-keepers, but does not entirely do away with it. Moreover, this method necessitates as many time-keepers as there are distances to be measured.

There is therefore a quasi-complication of the operations, which, in spite of all the care and honesty of the time-keepers, affords a loop-hole for the introduction of errors. Such errors are, to be sure, very slight, but, with the speeds obtained at present, they are capable of modifying the classification of a race or competition.

As things go to-day in the automobile line, considerable interests often hang upon fractions of a second. It is, therefore, of the greatest importance that the measurement of speeds shall be made with mathematical precision.

Our object is not to give in this place the various methods of timing employed or proposed. That we leave to the sporting committee of the Automobile Club, which is more competent and impartial than we ourselves could possibly be. Nevertheless, we wish to make a few remarks upon the apparatus at present in use, and to express our regret that the systems of timing have not kept in step with the progress and perfection of the machines that they are designed to time. While the speed of automobiles has risen from the few kilometers an hour that it was at the time of the first attempts at self-propelled vehicular locomotion, to the 136 actual kilometers, the system of chronometry has remained in the same condition that it was at the outset. But what was excellent at that epoch has to-day become entirely inadequate.

The fact must be thoroughly recognized that the human machine is poorly adapted for such a purpose, since, despite the skill of an expert, different external causes may influence him. *Errare humanum est.*

Very fortunately, the inexhaustible resources of modern science, mechanics, and electricity furnish us with all the elements needed for obtaining the result sought, and by making a suitable combination of certain of these elements, we shall be able to construct an apparatus sufficiently automatic to be styled the "auto-chronograph." The apparatus that we shall now describe possesses the following advantages:

(1) The total abolishment of direct manipulation by man and of the errors that he is liable to commit.

(2) The use of a single chronometric apparatus, whatever be the distance and the number of starters.

(3) The inscription upon a paper ribbon of the running time of the vehicle, which may consequently be easily read and compared, even several hours after a race.

(4) Great simplicity and transportability of the entire apparatus, the consequence of which is a minimum cost of construction and installation.

The apparatus consists of the following parts:

(1) An "electric contact band" or starting tape, consisting of a copper strip 8 or 10 cm. (3 or 4 inches) in width and 2 mm. (0.078 inch) in thickness, connected with the positive pole of a primary battery or an accumulator. Over this ribbon is stretched a "chaplet" composed of a small conducting wire, upon which are alternately strung small "beads" of copper and rubber, the latter of which are about twice as large as the former so as to prevent them from touching the tape. This wire is connected through the battery with one of the coils of an electro-magnet, which we shall have occasion to mention again further along in the description.

If we suppose that a vehicle passes over this device, it is easily seen that, whatever be its speed, its wheels will compress the rubber balls of the "chaplet" and force the copper ones to come into contact with the copper tape, the effect of which will be to send a current through the electro-magnet instantaneously.

(2) A second "electric contact band," similar to the first one, is placed across the road at the other end of the course, and takes the time of the finish.

(3) Third, there should be a source of electricity consisting of a small dry battery or a couple of accumulators, similar to those employed for the sparking of gasoline motors and designed to furnish the small quantity of current necessary.

(4) The fourth part is a special horseshoe electro-magnet, each pole of which terminates in a core, upon which is wound a coil of wire designed to re-inforce momentarily the attractive power of its respective poles. One end of each of these coils is connected with a common wire leading to the positive pole of the battery, and the other terminals of the coils run to the copper ribbons at the start and finish respectively. The wire of each "chaplet" is connected with the negative pole of the battery.

The poles of the magnet are surmounted by a centrally pivoted armature capable of slight vertical movement, to which is secured a stylus similar to that of registering barometers. This stylus is placed opposite a roll of paper ribbon that is unwound by the apparatus, and when the armature is attracted by the electro-magnet, the stylus touches the paper and traces a continuous line upon it.

(5) Finally, there is a perfectly isochronous clockwork movement, which recalls in its external appearance the "Mars" telegraphic receiver, and which is the chronometer proper, designed to measure the time, although its mechanism, instead of actuating hands, is utilized for unwinding the roll of paper ribbon (which is like that used in telegraphy) at a uniform speed in a given interval of time. Let us suppose such speed (which may be modified according to the precision that it is desired to obtain) to be a linear movement of 50 mm. per second, that is to say that every 50 mm. of tape unwound will represent 1 second of time, the fifth of a second will be represented by 50 ÷ 5, = 10 mm.; the tenth of a second by 50 ÷ 10, = 5 mm.; and the fiftieth of a second by 50 ÷ 50, = 1 mm.

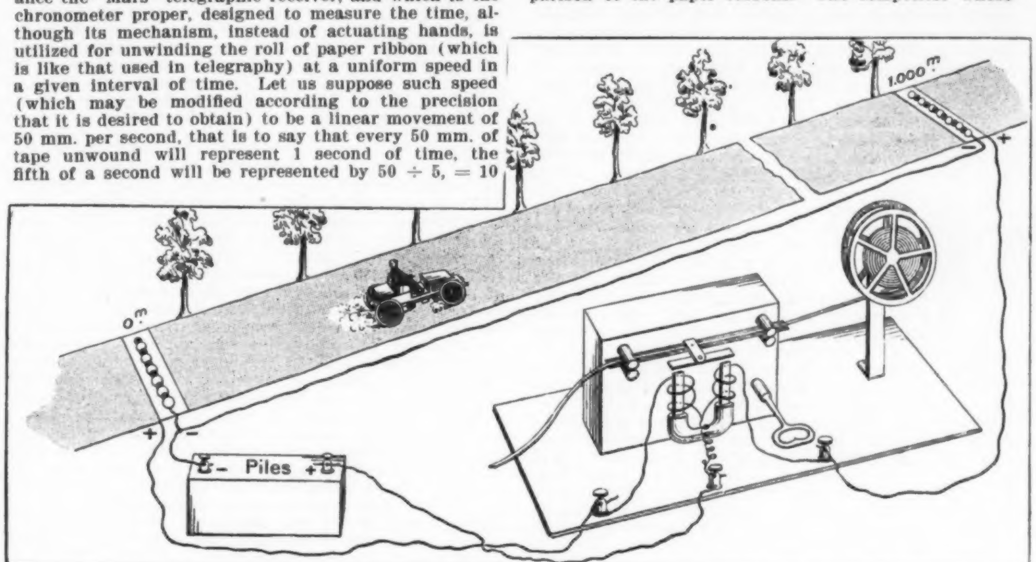


FIG. 1.—VIEW OF THE INSTALLATION OF THE AUTO-CHRONOGRAPH.

The apparatus hence permits of obtaining a precision unknown up to the present. As for slight variations in the running of the clockwork (fast or slow), they have no influence whatever upon the precision, since, taking place in the same apparatus and in the same direction, they counterbalance each other.

The system, as a whole, operates as follows: Let us suppose that we wish to obtain the time of a kilometer race, with a flying start. The first contact band will be placed across the track at the start, and the second across the track at the finish. The chronometric apparatus may be placed at any desirable point of the course, such as the starting or finishing points, or midway between the two. We shall suppose the electric circuit likewise established. The clockwork is set in motion, and as soon as it is running at its normal velocity, the operation may commence.

If, now, a vehicle be driven upon the track, its wheels as they pass over the starting tape will compress the "chaplet" and close the circuit through the coil pole of the horseshoe electro-magnet. This pole will instantly attract the armature, which will adhere to it after the circuit is broken. The stylus secured to the armature will then inscribe a continuous line upon the paper ribbon unwound by the clockwork movement. When the vehicle passes over the tape at the finish, its wheels will compress the "chaplet" placed there and close the circuit of the other coil of the horseshoe magnet, thus causing that pole of the magnet to attract the armature and raise the pen from the paper. The pen will cease tracing a line at this exact moment.

By the use of a single electric contact and owing to the absence of levers or other mechanical parts, the record is taken between precise moments of the passage of the vehicle over the starting and finishing points, and, consequently, with absolute accuracy.

The following is the manner of deducing the time:

It will be understood that the length of the line inscribed upon the tape by the stylus indicates the time that it has taken the vehicle to make the kilometer, and it is therefore easy to find the running speed of the machine.

Let us suppose that the length of the line is 1.205 m. Now, we know that each second is represented by 0.05 m. of paper. The quotient of 1.205 by 0.05 will therefore give us the number of seconds during which the vehicle has run.

$$\frac{1.205}{0.05} = 24\ 1\text{-}10 \text{ seconds.}$$

Now, the kilometer in 24 1-10 seconds represents

$$\frac{1{,}000 \times 3{,}600 \times 10}{241} = 149.377 \text{ kilometers an hour,}$$

which is the speed sought.

In practice, it is possible to do away with the operation of division by employing upon the apparatus rolls of paper ruled after the manner of a French dressmaker's meter measure. It will then suffice to read the number of divisions comprised in the length of the line (Fig. 2). If to this we add the use of a quickly read speed table, the chronometry will thereby be rendered entirely mechanical without any calculation, and consequently without any error.

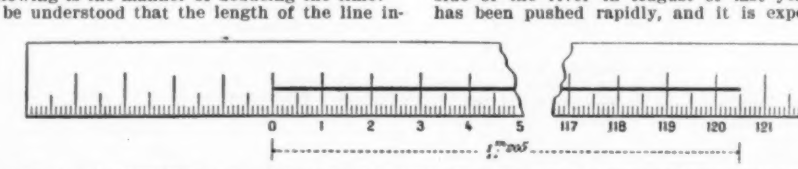


FIG. 2.—SPECIMEN OF A BAND FURNISHED BY THE AUTO-CHRONOGRAPH.

In the above example, we have designedly selected a speed much greater than any at present attained, and a fractional number of seconds for expressing the time, in order to bring into strong relief the precision and certainty of the measurements made by the apparatus. It would be impossible, in fact, to obtain such accuracy with ordinary chronometers.

This system, in addition to the high precision of the measurement that it effects, which permits of clearly estimating 1-50 of a second and less, possesses the immense advantage over the present process of preserving a graphic record of the result, thus shielding the time-keeper against suspicion or dispute, and allowing controversies to be settled immediately by a simple comparison of the paper ribbons. The competitor whose line is the shortest is evidently the one who has made the quickest time.

We believe that the use of an apparatus like the one under consideration would solve the very important question of chronometry and be well received by the majority of the manufacturers who participate in automobile races and competitions. It would immediately dissipate all fears of errors in chronometry or calculation.

Translated for the SCIENTIFIC AMERICAN SUPPLEMENT from an article by Maurice Espagnent in La Locomotion.

ELECTRIC POWER AT NIAGARA.

HARLAN W. BRUSH, United States consul at Niagara Falls, Ont., has some interesting things to say in a recent report to the State Department on "Development of Niagara Power." He says:

"The most important development of the year in this consular district is the enlarged production of electric power at Niagara Falls. This has been in use at Niagara Falls, N. Y., for several years past, and the demand for this cheap and constant power has been so urgent that it has been impossible for the power company to keep pace with it. The original development of 50,000 horse power at Niagara Falls, N. Y., was utilized some time ago, and the company has been working night and day to double the capacity of the plant, the tunnel providing for a discharge of water that would develop 100,000 horse power. The second shaft has been completed, the machinery has been installed, and within a few months the full capacity of the Niagara Falls, N. Y., plant will be at the service of the Niagara frontier.

"Realizing that the plant on the New York side of the cataract would only suffice for a short period, the power company commenced operations on the Canadian side of the river in August of last year. The work has been pushed rapidly, and it is expected that by next August 50,000 horse power will be available. Already, the demand is so great that last week the power company let a contract for extending the wheel pit at once, so as to develop 110,000 horse power instead of the 50,000 first contemplated. The two companies are practically identical as to stockholders, the Canadian company being officially designated as the Canadian Niagara Power Company.

"A radical departure from the installation on the New York side of the river is the utilization of dynamos of 10,000 horse power each instead of the 5,000 units that were installed in the original power house. The 5,000 horse power dynamos were such mammoth experiments that it was feared they would prove impracticable, but now they are to be succeeded by dynamos of twice their capacity. Quite a marked saving is effected in the construction of a 10,000 horse power dynamo over two of 5,000 each.

"The fact that cheap Niagara power is going to do all that was claimed for it in the way of attracting industrial concerns to the Niagara frontier is being so thoroughly demonstrated that a second company—the Ontario Power Company—has secured rights from the Canadian government. The development of its plant commenced last April, and 50,000 horse power will be the initial product, but this will be increased to 150,-

000 horse power. Instead of being carried in an underground tunnel, the water is directed into flumes, carried to the brink of the Niagara gorge, and then dropped into the river through penstocks, which develop the power.

"These two companies are backed almost exclusively by United States capital. A third company, which claims to be wholly Canadian, has applied to the government for the privilege of developing 100,000 horse power near the two plants now under construction. A full hearing of all the parties interested was given by the government on Friday, December 19, at Toronto, and a decision will be announced shortly. As special stress is laid on the fact that a Canadian company should have preferential rights, it is believed that the petition will be granted. The Canadian government exacts in all cases that 50 per cent of the power developed must be provided to Canadian consumers if called for; the balance will be exported to the United States.

"While millions of dollars are being expended in developing these various power plants, the revenue will be enormous. Comparatively little labor is required once the energy of Niagara is under control. When the 350,000 horse power now in process of development is placed on the market, the gross income of the power companies will be in the neighborhood of $7,000,000 per year. This is figuring the price at $20 per horse power a year, which is somewhat lower than the present average rate. As this provides constant power every day of the year, twenty-four hours every day, with thorough cleanliness, little fire or accident insurance, no expensive equipment for generating steam with its heavy annual wear and tear, no engineers or firemen—simply the turning of a lever—it is seen that for many lines of industry, Niagara electric power presents remarkable inducements.

"The industrial growth of the Niagara frontier in the past few years has been marvelous. It is prophesied that within ten years 1,000,000 horse power will be in course of development. Up to the present time, the effect on the volume of water passing over the falls is not noticeable, even with the most careful measurements. A short time since, for the purpose of inspection, all the water was shut off from power development for a number of hours. Competent men were stationed at different points on the river and at the brink of the falls to measure the difference in the river level when the water producing 100,000 horse power was cut off. The men were unanimous in their reports that they could not detect the slightest variation. A heavy wind blowing up or down Lake Erie will raise or lower the Niagara River several feet, but only those who are well acquainted with it will notice any special difference in the discharge at the cataract. The main change is in the middle channel of the river and is principally shown in the rate of discharge, rather than the raising or lowering of the river."

CONTEMPORARY ELECTRICAL SCIENCE.*

OPTICAL BEHAVIOR OF A CHARGED METAL SURFACE.—Since positively and negatively charged bodies behave differently in many physical processes, it seems probable that some difference should be observed in the effect of charging a metallic mirror positively or negatively on light reflected from the mirror. P. V. Bevan supposed that a charged metal consists of the metal itself in the ordinary condition with a surface layer of negative electrons or positive ions. The charge will alter the equations for the metallic medium by introducing this new layer, which, however, may be considered very thin as compared with the wave-length of light. The author works out the new equations, and arrives at the conclusion that to obtain a change of phase of 0.01 of a wave-length by reflection from a negatively charged surface the surface density must be $3{\cdot}2 \times 10^{5}$ electrostatic units per square centimeter. This is too great for practical observation. If a condenser consisting of two metallic films deposited on mica be used, and light transmitted through the positive and reflected from the negative film, the effect of the positive film would probably be much smaller than the other, and could be neglected. If the mica were 10^{-4} cm. thick, a sensible change of phase would be obtained with a difference of potential of 90,000 volts between the films. But it is hardly likely that the mica would stand the strain.—P. V. Bevan, Proc. Cambridge Phil. Soc., Easter, 1902.

INDUCED RADIO-ACTIVITY.—J. J. Thomson has undertaken an investigation to see whether the induced radio-activity shown by a metal rod after long-continued negative electrification in the open air would occur if the rod were placed in a closed vessel, instead of outside in the open air. The closed vessel was a zinc gasometer 102 cm. high and 75 cm. in diameter. The vessel was insulated and used as one of the electrodes, the other electrode being a metal tube placed at the axis of the cylindrical gasometer. These two electrodes served to measure the saturation current through the ionized gas, and any radio-activity of the rod would be indicated by an increase in the ionization, and consequently in the saturation current. Now, after the rod had been connected with the negative terminal of a Wimshurst machine for six or seven hours no increase in the current could be observed, showing that the rod had not acquired any radio-activity in the closed space. To impart such radio-activity, it was found necessary not only to keep the rod negatively electrified, but to temporarily ionize the air by means of Röntgen rays as well. On the Wimshurst and the Röntgen rays being shut off, the current showed an increase of some 16 per cent, which disappeared on substituting a similar rod which had not been electrified.—J. J. Thomson, Proc. Cambridge Phil. Soc., Easter, 1902.

PYRO-MAGNETISM AND PIEZO-MAGNETISM.—The phenomena of pyro-electricity and the more recently-discovered piezo-electricity may have magnetic analogies, though no positive results have hitherto been published. W. Voigt discusses them from the point of view of the electron theory, and comes to the positive conclusion that such magnetic analogies actually exist, though they are probably very small. The general argument is that if, as shown by the Zeemann effect, solid bodies contain electrons moving in closed orbits, then these electrons must have conditions of symmetry which depend upon the symmetry of the structure of the body, and nothing is in the way of supposing that crystals of certain systems acquire permanent magnetic moments which might be influenced by heat or pressure. The author is engaged in a systematic search for crystals showing the new magnetic properties. For this purpose crystals are divided into 32 groups, and are examined in the shape of cylinders. So far, the results have been practically negative. The magnetic moment per unit volume of dolomite is about 2,000 million times smaller than the electric moment per unit volume of tourmaline. In apatite the ratio is 55 million. It is remarkable that the occurrence of piezo magnetism is probable in 12 groups of crystals, and that of piezo-electricity in only three. The small value of the effects sought is due to the velocity of light appearing in the denominator.—W. Voigt, Ann. der Physik., No. 9, 1902.

NATURE OF RADIO-ACTIVITY.—E. Rutherford and F. Soddy show that the major part of the radio-activity of thorium is due to a non-thorium type of matter, ThX, possessing distinct chemical properties. This substance is temporarily radio-active, its activity falling to half its value in about four days. The constant radio-activity of thorium is maintained by the production of this material at a constant rate. Both the rate of production of the new material and the rate of decay appear to be unaffected by the most drastic physical and chemical transformations. Since the molecular condition of radio-active substances has no effect upon their radio-activity, the latter must be an atomic phenomenon. Since, at the same time, new types of matter are produced, the chemical changes producing them must be occurring within the atom. It is apparent that we are dealing with phenomena outside the sphere of known atomic forces. The only general conclusion we can draw is that the atoms after the process have an energy smaller than their original energy. The properties of matter that fulfill the necessary conditions for the study of chemical change without disturbance to the reacting system are few in number. Radio-activity may, therefore, take its place beside the spectroscope and the polariscope as a delicate and valuable new means of chemical research.—E. Rutherford and F. Soddy, Phil. Mag., September, 1902.

MECHANISM OF INDUCED RADIO-ACTIVITY.—J. J. Thomson, after describing some further experiments on air bubbled through water and on the ionization of air by a charged rod, furnishes the following theory of the phenomena observed. In consequence of the negative electrification of the wire, positive ions move up to it when it is placed in an ionized gas; some of the ions do not discharge to the wire, but stick close to it, forming a coating of positive electricity round it. Between this coating and the wire there will be a strong electric field tending to draw negative electricity from the wire. This will enable negative electrons to leave the wire, and if they thus move through a difference of potential of 2 volts they will ionize the gas by ionic shock. Thus the ionizing power of the wire is due to a kind of polarization, and the author has, indeed, succeeded in producing a similar ionization by means of a polarized negative electrode from an electrolytic cell. A similar theory will explain the fact that bubbling through water greatly increases the ionization of the air. The drops carried through the glass wool cannot greatly exceed 10^{-5} cm. in diameter. A layer of positive ions outside would pull out the negative electrons as before, and each drop would become a kind of cathode emitting ionizing cathode rays. The positive layer would be formed through the medium of H_2O_2.—J. J. Thomson, Phil. Mag., September, 1902.

DIMENSIONS OF CATHODE PHENOMENA.—Goldstein's first, second and third cathode layers are now known as the canal rays, the Hittorf or Crookes dark space, and the negative glow light. N. Hehl has made a special study of their dimensions in various circumstances. He confirms the observation that the cathode drop remains constant as long as the cathode is only partly covered with light. The length of the glow is directly proportional to the current strength. As long as the cathode is not quite covered the current strength is also independent of the amount of light covering it. The ratio of current density and pressure is constant in nitrogen, whereas in hydrogen the ratio of current to the square of the pressure is a constant. When the cathode is quite covered the potential increases directly as the current. The length of the canal ray space increases first rapidly, and then slowly, while the dark space decreases rapidly and then sinks down asymptotically. The most characteristic quantities in a vacuum discharge are the cathode drop, which is independent of the pressure but dependent upon the gas and the metal, and the current density existing when the cathode is incompletely covered with light. The latter is lower in hydrogen than in nitrogen, and lower with a cathode of platinum or graphite than with one of aluminium.—N. Hehl, Physikal. Zeitschr., September 1, 1902.

GASEOUS DISCHARGE IN A ROTATING MAGNETIC FIELD.—As an extension of Lecher's experiment with a conductor in a rotating magnetic field, J. J. Taudin Chabot substitutes for the wire a vacuum discharge. The magnet used was a bell electromagnet, and against its central piece was mounted a vacuum tube so that the magnetic field between the center and the circumference of the bell magnet traversed the tube radially. The current thread in the vacuum tube revolved about the magnet pole in the usual manner as discovered by Ampère, making about one revolution per second. Then the magnet and tube were set in rotation about a vertical axis, the connections being kept up by means of sliding contacts. It was then noticed that the rotation had a well-marked influence upon the magnetic rotation of the current thread, contrary to the case in the wire. The rate of rotation was sensibly accelerated by mechanical rotation in the same sense, and retarded or even reversed by a mechanical rotation in the opposite sense. On suddenly reversing the direction of rotation, it was noticed that the portions of the discharge nearest the electrodes changed first, and that the middle portion was dragged round apparently with reluctance. No induced currents owing to the alteration of the rotation were noticed.—J. J. Taudin Chabot, Physikal. Zeitschr., September 1, 1902.

* Compiled by E. E. Fournier d'Albe in the Electrician.

SELECTED FORMULÆ.

Production of Liquid Medicinal Soap.—J. Wilbert prepares liquid medicinal soap by the cold process as follows:

Cotton oil	200
Alcohol, 91 per cent	300
Water	325
Caustic soda	45
Potassium carbonate	10
Ether	15
Carbolic acid	25

The oil is mixed in a spacious bottle with water 100, alcohol 200, and caustic soda 45, and after saponification the remaining alcohol and the potassium carbonate dissolved in the rest of the water, and finally the carbolic acid and the ether are added and the whole well shaken. The mixture is filled in tightly closed bottles and stored at medium temperature. The preparation may be scented as desired, and the carbolic acid replaced with other medicinal agents.—Pharmaceutische Post.

Clothes Cleaners.—The Druggists' Circular and Chemical Gazette in a recent issue gives some formulas on the subject of clothes cleaning.

When the fabric is washable and the color fast, ordinary soap and water are of course sufficient in removing grease and the ordinarily attendant dirt; but special soaps are made for clothes cleaning which may possibly be more effective.

Here are several formulas for such preparations:

I. Powdered borax	30 parts.
Extract of soap bark	30 parts.
Oxgall (fresh)	120 parts.
Castile soap	450 parts.

First make the soap bark extract by boiling the crushed bark in water until it has assumed a dark color, then strain the liquid into an evaporating dish, and by the aid of heat, evaporate it to a solid extract; then powder and mix it with the borax and the oxgall. Melt the castile soap by adding a small quantity of water and warming, then add the other ingredients and mix well.

About 100 parts of soap bark make 20 parts of extract.

II. Castile soap	2 pounds.
Potassium carbonate	½ pound.
Camphor	½ ounce.
Alcohol	½ ounce.
Ammonia water	½ ounce.
Hot water, ½ pint, or sufficient.	

Dissolve the potassium carbonate in the water, add the soap previously reduced to thin shavings, keep warm over a water bath, stirring occasionally until dissolved, adding more water if necessary, and finally, when of a consistence to become semi-solid on cooling, remove from the fire, and when nearly ready to set, stir in the camphor, previously dissolved in the alcohol, and the ammonia.

The addition of the last named drugs is probably a survival of "shotgun" practice in making mixtures. The soap will apparently be quite as efficacious without them.

If a paste is desired, a potash soap should be used instead of the castile in the foregoing formula, and a portion or all of the water omitted. Soaps made from potash remain soft, while soda soaps harden on the evaporation of the water which they contain when first made.

A liquid preparation may be obtained, of course, by the addition of sufficient water, and some more alcohol would probably improve it.

Kid Glove Cleaner.—The Druggists' Circular and Chemical Gazette gives the following:

White castile soap, old and dry	15 parts.
Water	15 parts.
Solution of chlorinated soda	16 parts.
Ammonia water	1 part.

Cut or shave up the soap, add the water, and heat on the water-bath to a smooth paste. Remove, let cool, and add the other ingredients and mix thoroughly.

Dextrine Paste.—In hot water dissolve a sufficient quantity of dextrine to bring it to the consistency of honey. This forms a strong adhesive paste that will keep a long time unchanged, if the water is not allowed to evaporate. Sheets of paper may be prepared for extempore labels by coating one side with the paste and allowing it to dry; when to be used, by slightly wetting the gummed side, it will adhere to glass. This paste is very useful in the office or laboratory.

Laundry Bluing.—The following formula published in the National Druggist may be of interest:

Dissolve 217 parts of the potassium ferrocyanide in 750 parts of distilled water (fresh, clean rain water will answer), and to the solution add sufficient water to bring it up to 1,000 parts. In another vessel dissolve 100 parts of ferric chloride in a similar manner, in 1,000 parts of distilled or rain water. Make a cold saturated solution of sodium sulphate in water enough to make 4,000 parts (which will require between 1,400 and 1,450 parts of the sulphate). Now add one half of the sulphate solution to each of the other solutions (bringing each of them up to 3,000 parts). Finally add the solution of ferric chloride to that of the ferrocyanide in a little thin stream, under constant stirring, which should be maintained for several minutes after the last of the solution is added, or until there is no longer a separation of precipitate. Filter off or decant the liquor and wash the precipitate with clear water until the wash water comes off stained a deep clear blue color. After washing, spread the mass out to dry and let dry until pieces of it break with a fine bronze fracture. The drying may be done either by natural or artificial heat. The product is entirely soluble in cold water, and is the "soluble laundry blue" of commerce. If you will be guided by our advice, you will not go into the manufacture of bluing simply to supply the demand

for it that exists in the ordinary drug trade. You can purchase the article in balls, cakes, etc., from the manufacturers, and put them up in your own style of package at prices a good deal cheaper than you can make the bluing in small quantities, even were you an expert at the business.

Glue for Paper Bags.—The following is recommended by the Druggists' Circular and Chemical Gazette:

Glue	200 parts
Glycerin	50 parts
Syrupy glucose	10 parts
Tannin	1 part

Cover the glue with cold water, and let stand over night. In the morning pour off superfluous water, throw the glue on muslin, and manipulate so as to get rid of as much moisture as possible, then put in a water bath and melt. Add the glycerin and syrup, and stir well in. Finally dissolve the tannin in the smallest quantity of water possible, and add.

This mixture must be used hot.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Opening for an American House in Bangkok.—With the desire to impress upon my countrymen the belief that a paying business in Bangkok awaits an American house, I recently requested an American business man, who is well acquainted with trade throughout the Far East and has carefully studied this particular field, to give me his views on the subject. These practical and eminently common-sense opinions are sent as a supplement to my report of November 27, 1901—"Need of an American business house in Siam."* He says:

"With reference to the opening of a house in Bangkok for the sale of American goods, I will try to set down some of the points which I think should be taken into consideration.

"Of the two methods which might be followed, i. e., the forming of a company expressly for carrying on this particular work, or the opening of an office by one of the large trading companies in New York already doing business in other parts of the world, the latter would seem to be much the better plan, as the reputation of such a company is already well established; it is familiar with other foreign business methods, as well as with most of the lines of goods it would be called upon to handle in Siam; it would have its own methods of dealing with its home office, and would be on a better financial basis than another house which might attempt to do business in Siam alone. From what you have told me and from what I saw while in Bangkok, I believe with you that a house opened there by such a firm would pay, but it would be handicapped in some respects compared with the English or European houses already established, and would have to move somewhat cautiously at the start. According to my observation, practically every English or European house in the East is founded on some local business, in which the capital is controlled by their countrymen at home, the houses out here usually acting as managing agents. From this business they have by degrees built up their other and smaller lines of trade, depending largely on the local agencies for their support. These local managing agencies appear to cover in Siam much the same things as in Burma, viz., rice mills, timber, steamship companies, etc., while in India they embrace coal mines, tea estates, cotton mills, jute mills, leather, mica, shellac, etc., and in Ceylon and in the Straits tea or coffee estates, jewel or tin mines, and shipping companies. Most of these local houses then take up every conceivable line of business from which there is a probability of profit in their particular district, such as life and fire insurance, cotton piece goods, machinery, etc.

"An American house opening in Bangkok would of course not be able to start on a basis such as this, and would need to make a careful study of the local conditions and needs before beginning; and, while it might obtain considerable business from the government, I believe it would be found that it would have to depend for the bulk of its trade on the natives of the country. This is one reason why close study should be made beforehand of the local market; for, while the government and Europeans might demand the best articles in any particular line produced in America, the natives most likely would want something cheaper. This has been the experience, I know, of a number of houses in India, and the only American trading company there at present is working on this basis. I looked over their stock, both in Calcutta and Bombay, and while the material which the managers have imported is good and not cheap in appearance, like so much of the German product, it is not the best or most expensive that could be procured. Their business is almost entirely with the natives, with whom their goods appear to take well. The same thing is more or less true in regard to many of the English houses there.

"I have left until the last one of the most important points in a business of this kind, viz., that of payment. Few if any of the firms in America, from which a trading company establishing itself in Bangkok would have to buy, would be willing to accept long terms of payment, and most of them, I am sure, would demand cash against documents in New York, except in exceptional cases, when part payments extending over thirty to sixty days would probably be accepted. It seems therefore that local terms would have to be left entirely in the hands of the Bangkok branch, the home office in New York making payments there, and drawing on Bangkok at intervals, the Bangkok branch covering themselves for the delay in payments at this end by increase in their prices. A system used to some extent in India is that of having payments of small orders from native customers guaranteed by a responsible brokerage firm, who charge a small commission for doing so, this being paid by the customers. I believe you said that you knew of no such firm at present in Bangkok, but no doubt some of the Chinamen there would be willing to undertake it. If a house for the sale of American goods were opened in Bangkok, and could start by obtaining control of the importation of American flour, which you told me is large, I see no reason why it should not pay well. It would certainly be a good thing for American business, and I am sure that all producers and manufacturers at home, for whose product there would be any call, would do anything within reason to assist the movement.

"If what I have said here will be of any assistance to you in the solution of this matter, I shall be very glad, and I hope that if there is anything else that I can do in this connection you will let me know."

There is not in the whole of Siam at present one American house competent to consider a government contract, to push American trade, or to represent American interests. Other nationalities are well represented; they are constantly seeking business, and are ready to consider openings at once. It can not be expected that business will seek Americans here any more than in other countries, and if it is sought out by the consular representative, the three months' delay necessary for a reply from America will jeopardize our interests.

After four and one-half years' residence here I am persuaded that, for the right kind of people, there is an excellent business outlook in this country. A house to succeed in Siam must be of a standing that is recognized by the business world—one having connections in America, and whose name is a guaranty for its undertakings. It must be strong enough to consider any business proposition that may come up before it, and be able to attend to the lighter lines of trade as well. Such a house could secure the confidence of the government of Siam at once and would be welcomed by it. To build up American trade in Siam, the house must be run on American lines and managed by American business men. We cannot expect to succeed in business by farming out our interests to men of nationalities that have conflicting interests to be advanced. That a man has succeeded in business in America is no guaranty that he will succeed here, so different are the methods of carrying on trade in the Far East. One good man with business experience in the Orient is a necessity from the first. It would be well, indeed, if the house were connected with an American business already established in the Far East. It need not cut into the trade of those already engaged in importing from America, but might assist them and encourage others by facilitating shipping, easing terms of purchase, and offering the usual wholesale inducements at this end of the line. Such a house should be able to control, to its own benefit, to the advantage of the producers, and to the advantage of the local purchasers as well, all that America supplies to this market.

Electrical Supplies.—The electrical development of the city of Bangkok during the last ten years has been wonderful. The Siam Electricity Company, Limited, has a capital of £150,000 ($729,975), plus 200,000 ticals ($100,000 Mexican, or $46,000 in United States currency). It has 17,000 lamps of 16 candlepower, a tramway track of 11 miles in operation, and 40 cars in use and others under construction; it is supplying electric power for various industries throughout the city, and is considering a line of automobiles to be run in connection with its tram line. The manager is now in America on business for his company. A request for another concession on the other side of the river is being pushed, and there are 26 private plants in the various mills, forts, and dock companies, and in the navy yard of the city. The United States controls the market in this line now, and, with intelligent management, this trade could be greatly increased. In this connection the following table will be of interest, but it must be remembered that a large part of the goods therein credited to England and some credited to Germany are ordered from America through English and German houses who are represented here through their agents.

Electrical goods and apparatus imported from July 1, 1901, to June 30, 1902:

Country whence imported.	Quantity. Packages.	Value.	
United States	435	$61,746	*$28,403
England	176	34,041	15,639
Germany	103	13,915	6,401
Italy	3	304	138
Singapore	25	4,873	2,242
Hongkong	2	216	106
Total	744	$115,095	$52,949

Flour, etc.—Such a house should be able to handle the entire import of American flour. This now amounts to anywhere between 125,000 and 175,000 sacks per year, and the demand is constantly increasing. And there is no reason why the very large interests in tinned goods should not, if wisely handled, result to the greater benefit of both the producers at home and the traders in this market. The house could also handle clocks, bicycles, sewing machines, lamps, and other popular lines.

Cotton Goods.—The import of cotton and piece goods in this port amounted to about $5,000,000 Mexican ($2,375,000) last year, an increase of 40 per cent over the previous year. Of this, scarcely a dollar's worth comes from America; yet the only barriers are the present rate of freight and our demands for cash payments. The advantage that arises from the new lines of ships from New York to Singapore should go far toward overcoming the one and a local house could quite overcome the other. This is a trade that must constantly increase, for to produce these goods in a country where the raw material, the machinery, the labor, and the fuel must be imported is out of the question.

Water Supply and Sewerage.—Here is a great city of 1,000,000 souls, whose only water supply is rain during the seven months of the wet season and the foul and brackish waters of the rivers and canals during the five months of the dry season—a city which, because of this, loses its citizens by thousands every year from Asiatic cholera. The one escape from this scourge is a public water supply.

Here is a great flat city whose level in no spot throughout its area of 30 or 40 square miles rises 36 inches above high-water mark. During the high tides of October and November, all its natural levels are submerged. It has absolutely no system of sewerage, the construction of which would involve questions of scientific engineering of no mean quality. Yet these problems must be met and solved within the next decade.

Rice in Siam.—Siam is, with few exceptions, a great alluvial plain extending hundreds of miles to the north of Bangkok. This plain is capable of being made the richest rice garden of the world. As yet, the soil has been scratched in but the crudest way and in limited areas; nevertheless, its abundant harvests feed the millions of Siam's people and supply an enormous export every year. The very little that has been done to turn the jungle into productive fields has returned rich rewards in improved harvests, improved revenues, and improved homes. This great uncultivated plain lies ready to respond to the simplest processes of irrigation. Its area is vast, its soil is rich, and the quality of its rice stands first in the European market. The crop of 1901, because of a favorable season and an increased area sown, furnished about $16,000,000 gold of the exports, an increase of some $4,000,000 gold over any previous year in the history of the country. This was manufactured rice, which means not only an increased demand for agricultural implements, but for rice-milling machinery as well.

Irrigation.—Encouraged by such results, the government is developing a plan for a system of irrigation throughout the entire country under the supervision of a competent engineer. This must be effected in conjunction with the vast system of canals which form the highways of the country and intersect this vast plain in every direction. These, through years of neglect, have become choked. By the dredging of these old canals and the opening up of new ones, Siam's increasing harvests and improved industries must find cheap transport to the sea; and here is another problem that awaits solution.

Harbor Work.—The great mud flat at the mouth of the river, known as the bar, stretches away for miles, effectually blocking this splendid harbor against all shipping for a good part of the time, and against a good part of the shipping at all times—a hindrance to commerce, an expense to the trade, and a nuisance that finds no excuse for existence but the considerable outlay that would be required to remove it. The solution of this problem has probably been hastened by the recent discovery of a new channel somewhat deeper and considerably shorter, which shows the direction of the currents that could aid in opening a commodious entrance.

Railroads.—Siam's railroads are in their infancy, yet the little state has already spent the handsome sum of $16,200,000 Mexican ($7,452,000 gold), and her railroad plans extend well into the future. The disturbances in the north during the last few months have resulted in a decision on the part of the government to enter upon a programme of railroad construction not hitherto anticipated. To this end, a national loan of £1,000,000 ($4,865,500), or about 20,000,000 ticals, has been decided upon and the railway department has already under way the preparation of invitations for tenders for the supply of permanent way material for the northern line some 40 miles in length. This is to be followed immediately by a still further extension of the northern and probably by an extension of the southern line as well.

These are some of the plans and problems that confront this people for solution now; of the development of the mines and forests and the abundant agricultural resources, the future will speak. For a house competent to enter this field, there is probably no better business outlook in the world.

Notes.—Siam has a snug little navy, of which she is justly proud, and this, with her army of 10,000 soldiers, furnished with the most modern equipment, calls for constant supplies.

The foreign trade of Siam is increasing. In the year 1901, this trade was $17,207,551 Mexican ($8,173,587) in excess of that of the previous year, an increase of over 30 per cent.

Siam's finances are in excellent condition. Her revenues show a constant and healthy increase during the last eleven years; her European securities have increased over 14 per cent during the last year; her treasury balance has more than doubled at home; and she has no national debt. Undesirable taxes are being abolished; no new taxation is being imposed; a greater security of property encourages industry and thrift; and the people's wants are increasing with their prosperity.—Hamilton King, Consul-General at Bangkok.

Inquiry for Furniture in Russia.—The Bureau of Foreign Commerce has received from S. Zuckermann, Mohilew on Dnieper, a request for the addresses of several first-class firms trading in household furniture and stuffs for furniture.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

No. 1536. January 5.—The Simplon Railway—American Locomotives in England—Proposed Labor Arbitration in British Columbia.

No. 1537. January 6.—*United States Trade with France—Immigration into Northwest Canada—Blockade of Venezuelan Forts—Completion of Pacific Cable.

No. 1538. January 7.—New Zealand Labor News.

No. 1539. January 8.—France and Her Colonies—Heavier Rails for Prussian Railroads—Electricity for Purifying Drinking Water—American Petroleum for Greece—Manufacture of Glass in Germany—Knockdown Furniture for England.

No. 1540. January 9.—Development of Niagara Power—Forest Administration of British India—Cuban Customs Tariff—Coaling Station at the Seychelles.

No. 1541. January 10.—The Bank of France—New Source for German Cotton—Steam Power of Prussia in 1902—Russian Iron Industry—Tea Culture in the Caucasus—Dalny, Russia's Eastern Port.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

* Advance Sheets No. 1255; Consular Reports No. 258.

* Taking the mean value of the Mexican dollar as 46 cents.

TRADE NOTES AND RECIPES.

Lustrous Oxide on Silver.—The oxidation of silver is very simple, but some experience is necessary to reproduce a handsome black luster. Into a cup filled with water throw about 10 grammes of liver of sulphur and mix well. Scratch the silver article as bright as possible with the scratch brush and dip into the warm liquid. Remove the object after two minutes and rinse off in water. Then scratch it up again and return it into the liquid. The process should be repeated two or three times, whereby a wonderful glossy black is obtained.—Journal der Goldschmiedekunst.

To Restore Old Prints such as engravings, woodcuts and prints that have turned yellow, the National Druggist recommends the following procedure:

Old engravings, woodcuts or printed matter that have turned yellow may be rendered white by first washing carefully in water containing a little hyposulphite of soda, and then dipping for a minute in javelle water. To prepare the latter, put 4 pounds of bicarbonate of soda in a pan, pour over it 1 gallon of boiling water; boil for fifteen minutes, then stir in 1 pound of chloride of lime. When cold, pour off the clear, and keep in a jug ready for use.

To Renovate and Brighten Russet and Yellow Shoes the National Druggist gives the following methods:

The Illustrirte Schumacher Zeitung gives the following method of restoring to their original color yellow or russet shoes that have become darkened by wear or cleaning: First with a good stiff brush clean off all dirt and dust, then with a sponge dipped in benzin go over the leather, repeating the process as soon as the benzin evaporates. A few wipings will bring back the original color. Now use a light yellow dressing and brush well.

Gypsum, says Neueste Erfindungen und Erfahrungen, may be hardened and rendered insoluble by ammonium borate after the following method: Dissolve boric acid in hot water and add sufficient ammonia water to the solution that the borate at first separated is redissolved. The gypsum to be cast is stirred in with this liquid, and the mass treated in the ordinary way. Articles already cast are simply washed with the liquid, which is quickly absorbed. The articles withstand the weather as well as though they were of stone.

To Remove Rust from Iron or Steel Utensils the following solution, according to the National Druggist, may be applied by means of a brush, after having removed any grease by rubbing with a clean, dry cloth: 100 gm. stannic chloride are dissolved in 1 liter of water; this solution is next added to one containing 2 gm. tartaric acid dissolved in 1 liter of water, and finally, adding 20 c. cm. indigo solution diluted with 2 liters of water. After allowing the solution to act upon the stain for a few seconds, it is rubbed clean with first a moist cloth, later with a dry cloth; to restore the polish use is made of silver sand and jewelers' rouge.

For Affixing Labels to Glass says the Druggists' Circular and Chemical Gazette, mucilage of tragacanth is a satisfactory agent. The mucilage is made by simply pouring over the gum enough water to a little more than cover it, and then as the gum swells, adding more water from time to time in small portions, until the mucilage is brought to such consistency that it may be easily spread with the brush. The mucilage keeps fairly well without the addition of any antiseptic.

Flour paste may answer better if the labels are on unusually heavy paper; it is rather more troublesome to make on account of the necessary boiling and does not keep so well as the tragacanth paste.

By dissolving dextrin in cold water a tenacious paste is obtained. It has the disadvantage of possessing a slight odor, which odor is not agreeable.

Difficulty is often if not always experienced in attempting to affix paper to tin or other metals by paste which is efficient on glass. When the mucilage becomes practically free from moisture, it is apt to separate from the metallic surface. To obviate this, substances which have a strong attraction for water, such as calcium chloride, and glycerin, are added to the paste.

For a paste of this kind Eliel has proposed the following formulas:

I. Tragacanth	1 ounce
Acacia	4 ounces
Thymol	14 grains
Glycerin	4 ounces
Water, sufficient to make	2 pints

Dissolve the gums in 1 pint of water, strain and add the glycerin, in which the thymol is suspended; shake well and add sufficient water to make two pints. This separates on standing, but a single shake mixes it sufficiently for use.

II. Rye flour	8 ounces
Powdered acacia	1 ounce
Glycerin	2 ounces
Oil of cloves	40 drops
Water, a sufficient quantity.	

Rub the rye flour and acacia to a smooth paste with 8 ounces of cold water; strain through cheese cloth, and pour into 1 pint of boiling water and continue the heat until as thick as desired. When nearly cold add the glycerin and oil of cloves.

To Repair a Damaged Mirror is the subject of a note recently published in the National Druggist. Place the mirror face downward on a table and with a bit of cotton clean off the spot to be silvered, by rubbing it with a pledget of cotton. Now spread over the spot a piece of tinfoil a little larger than the area to be repaired, and after spreading out smoothly let fall on the center of it a drop of metallic mercury, and with a bit of chamois rub the foil until it becomes brilliant. Now place over the new amalgam a sheet of smooth writing paper and on it pile books or weights of any sort, and leave over night. The amount of weight needed is not great—just sufficient to keep the new amalgam in close contact with the glass. The amount of mercury needed should correspond as nearly as possible to 3 drachms to the square foot of surface to be resilvered. We may say, in conclusion, that while the above reads "easy," the job itself requires considerable practice to do it neatly and with dispatch.

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